THE FOUNDRY

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All Eyes Are Now Turned Toward Chicago

Arrangements for the Conventions of the Allied Foundry Associations and the Annual Exhibition of Foundry and Shop Equipment are Completed

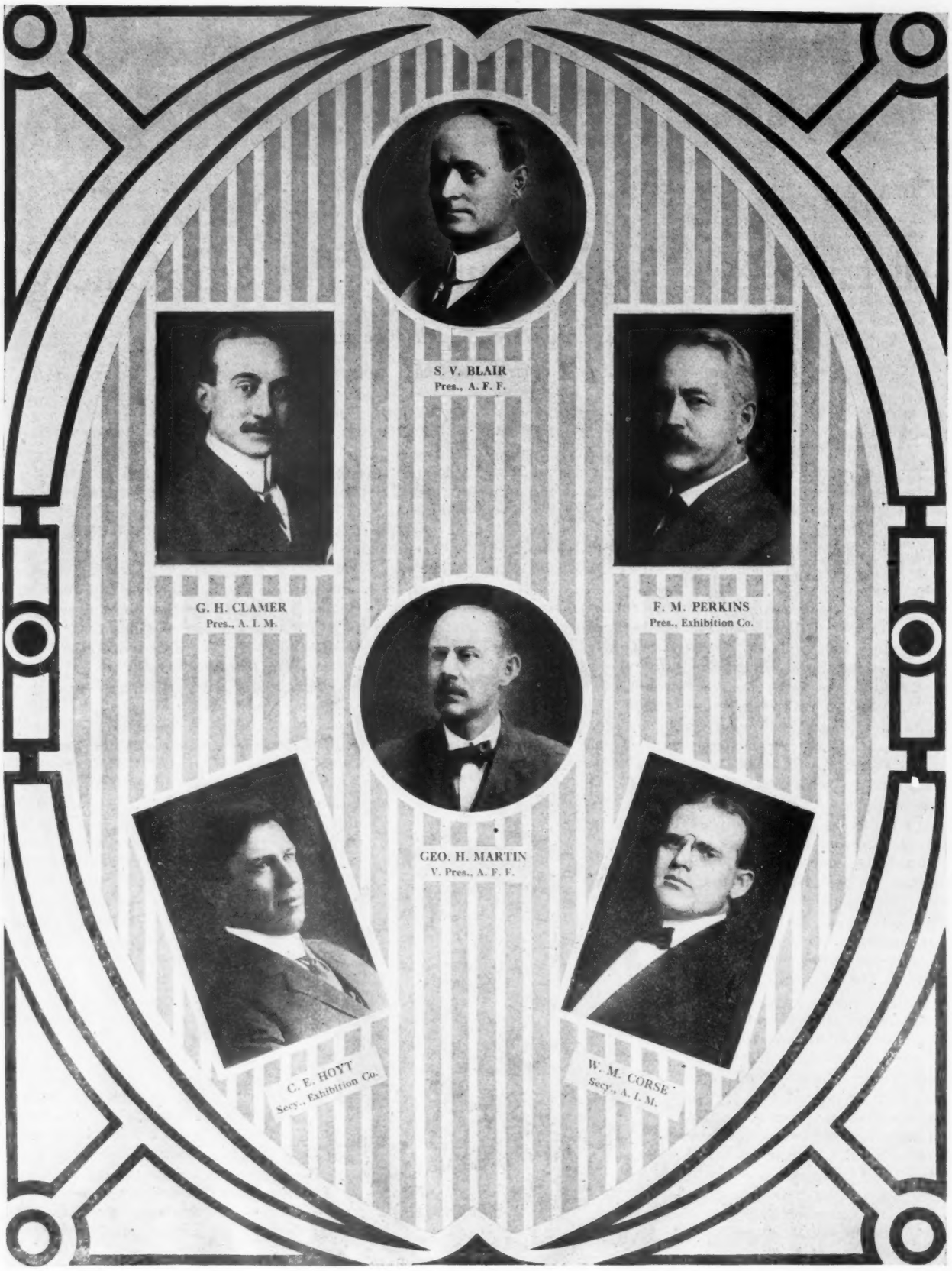
FOR THE third time in a little over a decade Chicago acts as host for the conventions of the allied foundry associations, and as such is once more the center of interest for the foundrymen of America. In addition, Chicago, up to date, is the only city to be honored with the convention two years in succession, but as the greatest foundry center in the world, with 170 individual casting plants, this distinction is merited. The 1914 convention will prove unique in many ways.

The purely sight-seeing element, which never has been a large factor in the attendance at the foundry conventions, this year will be almost completely eliminated, since it is hardly to be expected that those who attend merely for sight-seeing purposes would be interested in visiting Chicago two years in succession. The aggregate number of visitors, however, from present indications, will fully equal the tremendous total which was rolled up last year and will include only those who are seriously interested in the advancement of the foundry industry. The American Foundrymen's Association will discuss over 40 individual papers and reports, covering every phase of gray iron, malleable and steel foundry practice. The program of the American Institute of Metals is proportionately heavy and the Associated Foundry Foremen have arranged for a series of informal discussions of foundry practice. The programs have been carefully made up and related subjects will be considered in groups so that foundrymen who are interested in only one or two topics, and who are limited as to time, need to attend but one or two sessions in order to cover thoroughly their own particular subjects. Special attention is called to the Cost Congress, which will be held at the La Salle Hotel on Wednesday morning, Sept. 9. This session will be addressed by speakers of national reputation and the vital subject of foundry costs will be thoroughly covered from every angle. Like its predecessor, the 1914 exhibition of foundry and shop equipment will be housed in the International Amphitheater, Forty-second and Halsted streets, Chicago. This structure is located within 20 minutes' ride from the loop district of the city and is reached by the South Side elevated railway and by six surface car lines. Also, it is readily accessible by automobile, via Forty-third street, which connects with all of the north and south boulevards.

A. E. HOWELL,
Pres., A. F. A.

The exhibition will open on Saturday morning, Sept. 5, and will remain open continually during the day and evening until Saturday, Sept. 12, Sunday, Sept. 6, excepted. It has been suggested that companies which have a large number of men to send to the exposition will take advantage of the opportunity afforded them to have their employes attend in relays, thereby obviating interference with shop operations.

The conventions of the allied organizations, including the American Foundrymen's Association, the American Institute of Metals and the Associated Foundry Foremen will be held simultaneously from Tuesday until Friday, Sept. 8 to Sept. 11. The registration booths, however, will be open on Mnday, Sept. 7. Headquarters have been established by the American Foundrymen's Association at the La Salle Hotel, which will also be the headquarters for the American Institute of Metals. The Associated Foundry Foremen will have their headquarters at the new Fort Dearborn Hotel on Van Buren street, adjacent to the La Salle street station. The headquarters of the Foundry & Machine Exhibition Co. are at the Sherman Hotel. The meetings will commence Tuesday morning, Sept. 8, at 10 a. m., at the La Salle Hotel with a joint session of the three associations. The customary addresses of welcome and response will be given at this time, together with the annual addresses of the presidents of the allied associations. Following these features, seven important papers on safety in foundry operations will be read and discussed. On Tuesday the associations will



OFFICERS OF THE AMERICAN INSTITUTE OF METALS, THE ASSOCIATED FOUNDRY FOREMEN AND THE EXHIBITION COMPANY

Program, American Foundrymen's Association

Tuesday, Sept. 8, 10 a. m., La Salle Hotel.

Joint session, American Foundrymen's Association, American Institute of Metals and Associated Foundry Foremen

1—Address of Welcome, by H. O. Lange, Chairman, General Committee.

2—Annual Address, Alfred E. Howell, President, American Foundrymen's Association.

3—Annual Address, G. H. Clamer, President, American Institute of Metals.

4—Annual Address, S. V. Blair, President, Associated Foundry Foremen.

5—"Safety in Foundry Operations", illustrated address by M. W. Alexander, West Lynn, Mass.

6—"Notes on Safety Organization", illustrated address by A. W. Gregg and G. F. Kent, Milwaukee.

7—"Sanitation and Safety First Applied to the Brass Industry", illustrated address by F. Moerl, Chicago.

8—"Progress in the Safety First Movement", illustrated address by Arthur T. Morey, Granite City, Ill.

9—"Safety First", by F. W. Reidenbach, Rochester, N. Y.

10—"Safety in Connection with Grinding Wheel Operations", by R. G. Williams, Worcester, Mass.

11—"Safety First—Driving Back the Saloon", by Thomas D. West, Cleveland.

Tuesday, Sept. 8, 2 p. m., La Salle Hotel.

Individual session, American Foundrymen's Association.

12—Annual report of executive committee.

13—Annual report of Secretary-Treasurer.

14—"Electric Motors and Controllers for Foundry Operations", by S. H. Libby, New York.

15—"The Two-Story Foundry," by G. K. Hooper, New York. York.

16—"Economics of Motor Drive", by H. F. Stratton, Cleveland.

17—"The Selection of Grinding Wheels for the Foundry", by Carl Frederick Deitz, Worcester, Mass.

18—"Refractories—Their Selection and Use in the Foundry", by Walter H. Kelley, Pittsburgh.

19—"Molding Sand Tests", by Dr. Richard Moldenke, Watchung, N. J.

20—"Report of the Committee on Industrial Education", by Paul Kreutzpointner, Altoona, Pa.

"A New Design for Cupola," by G. R. Brandon, Harvey, Ill.

Tuesday, Sept. 8, 7:30 p. m.

Lake Ride, Steamer *Theodore Roosevelt*, Dock foot of Clark street bridge.

Wednesday, Sept. 9, 10 a. m., Palm Room, Stock Yards Inn.

"Cost Congress," joint session, American Foundrymen's Association and American Institute of Metals.

21—"Foundry Cost Keeping", address by F. J. Stephenson, Cost Expert, National Association of Stove Manufacturers, Hoosick Falls, N. Y.

22—"Efficiency in Foundry Operations, the Essential Factor in Reducing Production Costs", address by A. K. Hathaway, Philadelphia.

23—"Prevailing Practice in Estimating the Selling Price of Castings", by A. O. Backert, Cleveland.

24—"Scientific Management in the Foundry", by Frederic A. Parkhurst, Detroit.

25—"Revision of the A. F. A. Standard Foundry Cost System", by Harrington Emerson and J. K. Mason, New York.

26—"Elimination of Waste in Bench Molding", by J. C. Pendleton and R. E. Kennedy, Urbana, Ill.

27—"Industrial Pioneering, or the Establishment of a Foundry in a New Territory", by L. L. Anthes, Toronto.

28—"The Training of Foremen, Superintendents and Managers of Foundries", by E. A. Johnson, Boston.

29—"Dangers of Specialization", by Thomas D. West. Cleveland.

Wednesday, Sept. 9, 1 p. m.

Ladies' Luncheon, Stock Yards Inn.

Wednesday, Sept. 9, 2 p. m., Palm Room, Stock Yards Inn.

Individual session, American Foundrymen's Association.

30—"Calculating Mixtures for Malleable Cast Iron", by Harrold Hemeway, Moline, Ill.

31—"Effect of Varying Silicon and Carbon in Malleable Iron Mixtures", by A. L. Pollard, Batavia, N. Y.

32—"Some Remarks on the Strength and Ductility of Malleable Cast Iron after the Skin has been Removed", by Enrique Touceda, Albany, N. Y.

33—"Malleable Iron, Its Manufacture, Characteristics and Uses", by J. P. Pero, East St. Louis, Ill.

34—"Researches in the Annealing Process for Malleable Castings", by Oliver W. Storey, Madison, Wis.

Thursday, Sept. 10, 10 a. m., Palm Room, Stock Yards Inn.

Individual session, American Foundrymen's Association.

35—"The Electric Furnace in the Steel Foundry", by W. L. Morrison, Welland, Ont.

36—"Making Steel Direct from Ore in the Electric Furnace", by Prof. T. A. Louden, Toronto, Ont.

37—"Side-Blow Converter Practice", by John Gregson, Milwaukee.

38—"Manufacture of Acid Steel for Castings", by A. F. Blackwood, Detroit.

39—"Notes on the Microstructure of Steel", by Prof. Wm. Campbell, New York City.

40—"Some Defects in Steel Castings and Remedies for Them", by John Howe Hall, New York.

41—"Reports of the Committee on Steel Foundry Standards", by Dudley Shoemaker, Chairman, American Steel Foundries, Indiana Harbor, Ind.

Thursday, Sept. 10, 2 p. m., Palm Room, Stock Yards Inn.

Individual Session, American Foundrymen's Association.

42—"Cast Iron with Unusual Structure", by K. W. Zimmerschied, Detroit.

43—"Iron and Its Properties", by Peter F. Blackwood, Detroit.

44—"Report on the Conservation Congress", by Paul Kreutzpointner, Altoona, Pa.

45—"Green Sand Cores", by James Mulvey, Troy, N. Y.

46—"Memorandum on the Preparation of Standard Specifications for Cast Iron for International Export Use", by Dr. Richard Moldenke.

47—"Semi-Steel", by R. H. Probert, Springfield, O.

48—"Tests of Cast Iron", by W. P. Putnam, Detroit.

49—"Material for High Grade Castings," by J. E. Johnson Jr., Detroit.

Thursday, Sept. 10, 7 p. m.

Annual Banquet, La Salle Hotel.
Ladies' Banquet, La Salle Hotel.

Friday, Sept. 11, 10 a. m., Palm Room, Stock Yards Inn.

Individual session, American Foundrymen's Association.

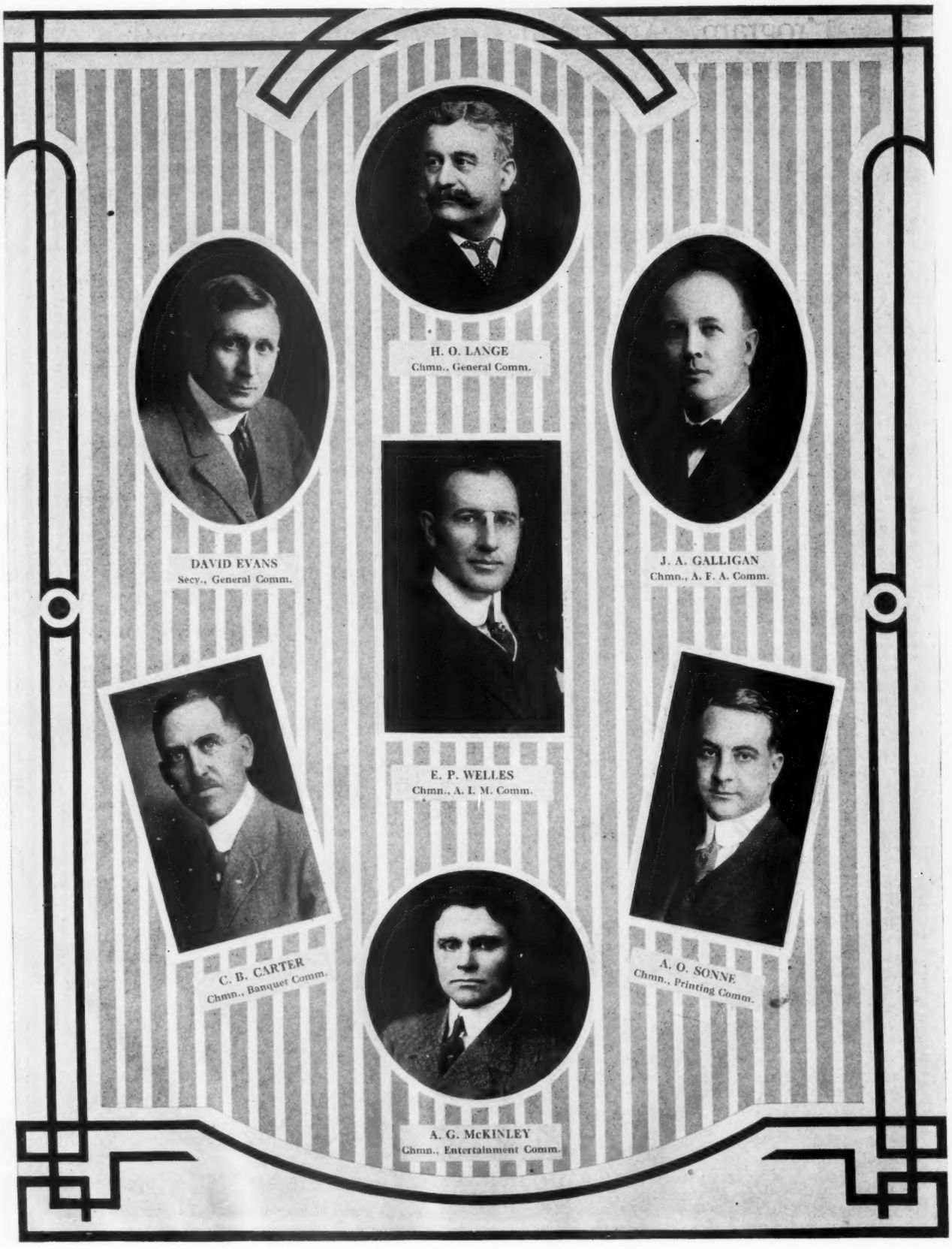
50—Reports of officers and special committees.

51—Unfinished business.

52—New business.

53—Election of officers.

Friday, Sept. 11, 12:30 p. m.

Sight-seeing tour of industrial Chicago, special train furnished by the Chicago Association of Commerce will leave the International Amphitheater at 12:30 P. M.

PROMINENT MEMBERS OF THE LOCAL COMMITTEES AT CHICAGO

Program, American Institute of Metals

Tuesday, Sept. 8, 10 a. m., La Salle Hotel.
Joint meeting with the American Foundrymen's Association.
(For details see A. F. A. Program)

Tuesday, Sept. 8, 2 p. m., La Salle Hotel.

Report of Official Chemist, by Arthur D. Little, Inc.

"Progress in the Nomenclature of Alloys", by G. K. Burgess.

"Some Recent Applications of Metallic Cobalt", by D. B. Browne.

"Drop Pouring Process of Castings", by E. A. Barnes.

"Bull Run Talc", by Jesse L. Jones.

"Modern Die-Casting Practice", by Charles Pack.

"Die Cast Aluminum", by A. B. Norton.

"Non-ferrous Alloys for Automobile Construction", by E. B. Horne.

Wednesday, Sept. 9, 10 a. m., Palm Room, Stock Yards Inn.
Cost Congress, Joint session with A. F. A.

Wednesday, Sept. 9, 1:00 p. m.
Ladies Luncheon.

Wednesday, Sept. 9, 2 p. m., Saddle and Sirloin Club, Stock Yards

"Care and Conversion of Rolling Mill Scrap", by W. W. Rogers.

"A Brief Visit to a Rolling Mill", by Edward J. Gutsche.

"A Hot Shortness Testing Machine for Aluminum Alloy", by A. B. Norton

"Making Aluminum Test-Specimens on Castings", by A. B. Norton.

"Standard Test Bars of the Zinc and Bronze, Copper 88, Tin 10, Zinc 2", by C. P. Karr.

"A New Method for the Determination of Zinc in Alloys", by G. E. Lundell and Mai Kim Bee.

"Brinnell Hardness Testing of Non-Ferrous Alloys", by V. Skillman.

Thursday, Sept. 10, 10 a. m., Saddle and Sirloin Club.

"Commercial Classification of Copper", by Lawrence Addicks.

"Spelter Manufacture and Properties", by George C. Stone.

"Metallurgy of Tin and Antimony", by W. A. Cowan.

"Ternary Alloys of Copper, Tin and Zinc", by S. L. Hoyt.

"The Effect of Repeated Remelting on Copper", by F. O. Clements.

Thursday, Sept. 10, 2 p. m., Saddle and Sirloin Club

"Tests of Electric Furnaces for Brass Foundry", by Herbert E. Dorsey.

"Electric Furnace for Medium Temperatures", by E. M. Schmelze.

"Electric Brass Melting from the Central Station Viewpoint", by H. M. St. John.

Thursday, Sept. 10, 7 p. m., La Salle Hotel.
Annual Convention Banquet and Ladies' Banquet.

Friday, Sept. 11, 10 a. m., Saddle and Sirloin Club.

"Melting Losses in Electric Brass Furnace", by H. W. Gillett and J. M. Lohr.

"Use of Producer Gas in Melting Yellow Brass", E. B. Guenther.

"Test of Natural Gas Fired Furnaces Under Factory Conditions", by Fred L. Wolf and Robert B. Burr.

"Electric Brass Melting", by G. H. Clamer and Carl Hering.

"Pyrometers for Melting Brass and Bronze", by H. W. Gillett.

have individual sessions and on Tuesday evening the visiting foundrymen will enjoy a boat ride on Lake Michigan on the steamer *Theodore Roosevelt*. Wednesday morning, at 10 a. m., in the Palm room of the Stock Yard Inn, adjacent to the exposition, will be held the joint Cost Congress of the American Foundrymen's Association and the American Institute of Metals. On Wednesday noon the ladies will be tendered a luncheon at the Stock Yard Inn. Professional sessions will be held on Wednesday afternoon and on Wednesday evening the White City, Chicago's famous amusement park, will be the center of attraction. Simultaneous professional sessions will be held on Thursday, concluding with the annual convention banquet at the La Salle Hotel, Thursday evening at 7 p. m. At the same time, a special dinner will be given for the ladies, also at the La Salle Hotel. On Friday the Chicago Association of Commerce will furnish a special train to tour Chicago's many industrial sections.

The local arrangements are in charge of an able committee of Chicago foundrymen headed by H. O. Lange, of the Ferguson & Lange Foundry Co., chairman of the general committee, assisted by David Evans, of the Chicago Steel Foundry Co., secretary of the general committee. H. L. Hanson, of the Chicago Steel Foundry Co., is assistant secretary of the general committee.

The reception committee for the American Foundrymen's Association consists of the following: J. A. Galligan, Pickands, Brown & Co.; L. C. Young, McDowell Foundry Co.; William Francis, Francis & Nygren Foundry Co.; Eugene Smith, Crane Co.; Alex. Thompson, H. W. Caldwell & Son Co.; Thomas J. Sheriff, Sheriff Mfg. Co.; J. G. Garrard, Northwestern Iron Co.; James Wood, Sheffield Foundry Co., and J. P. O'Niel, Western Foundry Co.

Condensed Program

Saturday, Sept. 5.
10:00 A. M.—Opening of the exhibition at International Amphitheatre.

Monday, Sept. 7.
10:00 A. M.—Registration, La Salle Hotel.
7:00 P. M.—Banquet, Associated Foundry Foremen, Fort Dearborn Hotel.

Tuesday, Sept. 8.
10:00 A. M.—Joint Session, American Foundrymen's Association, American Institute of Metals and Associated Foundry Foremen.
2:00 P. M.—Professional Sessions, A. F. A. and A. I. M., La Salle Hotel.
7:30 P. M.—Lake Ride, Steamer *Roosevelt*.

Wednesday, Sept. 9.
10:00 A. M.—Joint session, A. F. A. and A. I. M., Stock Yards Inn.
1:00 P. M.—Ladies' luncheon, Stock Yards Inn.
2:00 P. M.—Professional sessions, A. F. A. and A. I. M., Stock Yards Inn.
8:00 P. M.—Visit to the "White City."

Thursday, Sept. 10.
10:00 A. M.—Professional sessions, A. F. A. and A. I. M., Stock Yards Inn.
2:00 P. M.—Professional session, A. F. A. and A. I. M., Stock Yards Inn.
7:00 P. M.—Annual convention banquet, La Salle Hotel.
7:00 P. M.—Annual banquet for ladies, La Salle Hotel.

Friday, Sept. 11.
10:00 A. M.—Professional sessions, A. F. A. and A. I. M., Stock Yards Inn.
12:30 P. M.—Sight-seeing tour, train leaves International Amphitheatre.
6:00 P. M.—Exhibition closes at International Amphitheatre.

The reception committee for the American Institute of Metals consists of the following: E. P. Welles, Charles H. Besly Co.; I. M. Bregowsky, Crane Co.; I. N. Perlstein, Great Western Smelting & Refining Co.; Fred Moerl, Pullman Co.; Charles McNellis, Imperial Brass Mfg. Co., and Harold Wolff, L. Wolff Mfg. Co. Other local convention committees follow:

Entertainment Committee — A. G. McKinley, Griffin Wheel Co.; S. T. Johnston, S. Obermayer Co.; C. A. Harding, Whiting Foundry Equipment Co.; C. E. Hoyt, Foundry & Machine Exhibition Co., and Harry Pridmore, Henry E. Pridmore.

Banquet Committee—C. B. Carter, American Brake Shoe & Foundry Co.; N. C. Peebles, Edgar Allen American Manganese Steel Co., and O. J. Abell, *Iron Age*.

Printing Committee—A. O. Sonne, Rogers, Brown & Co.; Richmond Nicholas, Hickman, Williams & Co., and A. B. Hawes, Mathew Addy & Co.

Exhibition of Foundry Equipment and Supplies

List of the Exhibitors and Details of Their Displays—Great Show to be Held at the International Amphitheater, Chicago, Sept. 5 to 12

ACME MACHINE TOOL CO., Cincinnati.—A motor-driven 3¼x 36-inch flat turret lathe with a geared head and provided with both bar and chucking equipment will be shown in operation; represented by J. R. Pearson and Joseph M. Herrman.

AJAX METAL CO., Philadelphia. — This exhibit will consist principally of non-ferrous ingot metals, babbitt metals and white metals, including bronzes of various kinds, brasses, bearing metals, etc.; represented by G. H. Clamer, H. L. Carpenter Jr., Frank M. Willeson, C. F. Hopkins and William J. Coane.

AMERICAN PULLEY CO., Philadelphia.—Steel split pulleys will be displayed.

ARCADE MFG. CO., Freeport, Ill.—The various types of molding machines manufactured by this company, will be exhibited, including jolt-ramming machines, Modern machines of the hand and air power types, hand and air power squeezers, combined jolters and squeezers, core jolting and piston molding machines, sand sifters, gray iron foundry pouring device and pattern plates of various types; represented by E. H. Morgan, Chas. Morgan, L. L. Munn, F. N. Perkins, August Christen, G. D. Wolfley, W. C. Norcross, R. E. Turnbull, and Henry Tscherning.

ARMSTRONG-BLUM MFG. CO., Chicago.—Hack saws.

ATKINS, E. C., & Co., Indianapolis.—A new line of metal-cutting saws.

AYER & LORD TIE CO., Chicago.—An extensive display will be made of "Interior" creosoted wood blocks, a sample pavement of which will be shown. In addition blocks will be exhibited that have been taken from floors in service various lengths of time, and similar blocks will be shown that have been removed from street pavement, etc. In addition, samples of creosoted timbers for building purposes, etc., will be exhibited; represented by A. H. Noyes, B. S. McConnell, Frank A. Weaver, James Adkins Jr., and E. L. Parvin.

BARBER-COLEMAN CO., Rockford, Ill.—Milling machines and milling cutters.

BATTLE CREEK SAND SIFTER CO., Battle Creek, Mich.—Sand sifters.

BENJAMIN ELECTRIC MFG. CO., Chicago.—Electric lighting fixtures.

BERKSHIRE MFG. CO., Cleveland.—The complete line of molding machines manufactured by this company, will be shown in operation. The exhibit will include machines of the following types: Automatic air squeezer, hand squeezer and core making machines, vibrators and other small equipment also will be shown; represented by R. H. York, W. A. Price, W. D. Fraser, F. Hulec and G. L. Cannon.

BESLY, CHAS. H., & CO., Chicago.—Surface grinders and grinding machinery.

BIRKENSTEIN, S. & Sons, Chicago.—This exhibit will consist of the following metals and alloys cast in various forms for convenient use in the brass foundry: Lake copper, tin, aluminum, antimony, lead, babbits, solders, brass and bronze ingots.

BLYSTONE MFG. CO., Cambridge Springs, Pa.—The core sand and facing mixer built by this company will be shown in operation. This machine will be exhibited both with and without the riddling attachment; represented by H. J. LeFevre.

BOND FOUNDRY & MACHINE CO., Manheim, Lancaster Co., Pa.—A complete line of power transmitting machinery will be shown. This exhibit will be in charge of the company's western agents, The Reeves Pulley Co., Chicago.

BROWN & SHARPE MFG. CO., Providence, R. I.—Plain grinding machine, universal and heavy plain milling machines, automatic screw machines, milling cutter, etc., will be shown. The plain grinding machine is new in design and has an interesting type of drive for the work table. The automatic screw machine is also new; it has a constant speed drive and can be belted direct to the main line without using a countershaft; represented by G. B. Bealle, F. B. Evans and R. E. Doras.

BROWN SPECIALTY MACHINERY CO., Chicago.—A complete line of core making machines will be shown, including three styles, equipped to make round cores from ⅜ to 3 inches, ½ to 5 inches and ⅝ to 7 inches. These machines also are designed to produce square, round, hexagon, and odd shaped cores within the capacity of the respective machines. Core-tapering and cutting-off machines as well as electric and pneumatic shakers also will be shown; represented by Elmer A. Rich Jr., Herbert T. Rich, John Laycock, and Robert Laycock.

BUCH FOUNDRY EQUIPMENT CO., Bridgeport, Pa.—A compllete line of molding machines.

BUCKEYE PRODUCTS CO., Cincinnati.—A line of partings, core compounds, metal fluxes, high temperature furnace cements, air vibrators and metal melting furnaces manufactured by this company will be exhibited; represented by C. J. Goehringer, J. W. Mann, R. B. Ferguson, W. F. Panek and B. Bernbaum.

CARBORUNDUM CO., Niagara Falls, N. Y.—A complete line of carborundum and aloxite wheels for foundry work, carborundum and aloxite paper and cloth, carborundum rubbing bricks and carborundum and aloxite discs, will be exhibited; represented by G. R. Rayner, C. C. Schumaker, O. C. Dobson, J. H. Jackson, R. H. Kerwin and C. D. Bradbury.

CATARACT REFINING & MFG. CO., Buffalo.—Samples of liquid core compound, parting and a full line of cores made from the liquid core compound manufactured by this company will be displayed. In addition, cutting compounds, cutting oils and soluble oil also will be shown; represented by R. J. Collins, D. L. Baldwin, J. Purvis Jr., W. E. Williams, H. C. Newton, T. J. Kenefick and E. H. Coburn.

CENTRAL IRON WORKS, Quincy, Ill.—The space reserved by this company will be fitted up as a rest room for visiting foundrymen and literature showing this company's line of equipment including cinder and tumbling mills, dust arresters, core ovens, sand mixers and sand blast equipment, will be distributed; represented by F. M. Brown, Alfred Anderson, Chas. G. Howe and W. T. Lechtenberg.

CHICAGO PULLEY & SHAFTING CO., Chicago.—A ball bearing shaft hanger will be shown; represented by S. A. Ellicson and F. A. Mills.

CHICAGO PNEUMATIC TOOL CO., Chicago.—Air rammers and a complete line of pneumatic machinery.

CLARK, JAS., JR., ELECTRIC CO., Louisville.—A complete line of electrically-driven tools manufactured by this company including portable electric, sensitive, two and three-spindle radial and semi-radial drills, power hack saws, grinders of various types, motors and generators will be shown; represented by W. W. Crooker, James Clark Jr. and Chas. E. Willey.

CLARK, CHARLES J., Chicago.—Cupola blast meter.

CLEVELAND PNEUMATIC TOOL CO., Cleveland.—This exhibit will consist of a complete line of pneumatic tools for foundry use, consisting of riveting and chipping hammers, sand rammers for bench, core, floor and flask ramming, portable emery grinders, valve grinders, various types of air, corner, rotary and breast drills, as well as core breakers and couplings. All of the foundry tools will be shown in operation; represented by H. S. Covey, Arthur Scott, C. J. Albert and J. A. Day.

CLIPPER BELT LACER CO., Grand Rapids, Mich.—Steel belt lacing.

COBURN TROLLEY TRACK MFG. CO., Holyoke, Mass.—Two different styles of overhead mono-rail, especially adapted to foundry uses, will be displayed and motion pictures will be shown illustrating foundry mono-rails in operation; represented by W. D. Ballard.

CONSOLIDATED PRESS & TOOL CO., Chicago.—Presses and metal working machinery.

COWAN TRUCK CO., Holyoke, Mass.—Trucks for shop use.

CURTIS PNEUMATIC MACHINERY CO., St. Louis, Mo. — Overhead traveling crane, jib crane, overhead trolley system, Curtis foundry hoist, sand blasts and air compressors, all of which will be in operation, will be displayed. Also photographs of interesting foundry elevator and casting-breaker installations; represented by E. J. Clark and L. C. Blake.

DEMMLER, WILLIAM, & BROS., Kewanee, Ill.—Molding machines.

DIXON, JOSEPH, CRUCIBLE CO., Jersey City, N. J.—A non-skimming crucible, bottom pouring crucible, standard crucibles of various types, etc., will be displayed; represented by D. A. Johnson, W. B. Allen, H. C. Sorenson, F. R. Brandon and Frank Krug.

EDGEMONT MACHINE CO., Dayton, O.—Samples of the entire line of equipment manufactured by this company will be exhibited, including line shaft clutches, cut-off couplings, gas engine clutches and friction clutch countershafts; represented by George Stahl, W. P. Coffman and O. B. Coffman.

ELECTRIC CONTROLLER & MFG. CO., Cleveland.—Electric controlling devices, lifting magnets, etc.

ESSLEY, E. L., MACHINERY CO., Chicago.—This display of machine tool equipment will include the products of the following manufacturers: American Tool Works Co.,

Cincinnati, 14-inch x 6-foot, 20-inch x 10-foot, 36-inch x 14-foot high duty engine lathes; 15-inch and 24-inch high duty shapers; 2, 3 and 6-foot heavy duty plain radial drills and a 24 x 24-inch x 6-foot planers; represented by J. B. Doan, Robert S. Alter, J. C. Hussey and C. K. Cairns. The Cincinnati Pulley Machinery Co., Cincinnati, several styles of high speed ball bearing drill presses, from one to six spindles; represented by L. B. Patterson and J. G. Hey. The Diamond Machine Co., Providence, R. I., automatic surface grinder and a motor driven 84-inch guide bar grinder; represented by Messrs. Wight and Slepkow. International Machine Tool Co., Indianapolis, 26-inch turret lathe with 7½-inch hollow spindle; represented by O. B. Iles, C. L. Libby and F. B. Huston. Barnes Drill Co., Rockford, Ill., 20-inch heavy duty drill press; represented by B. F. Barnes and J. C. Andress. Colburn Machine Tool Co., Franklin, Pa., heavy duty high speed drill press and a 54-inch vertical boring mill, both motor driven; represented by H. L. Colburn and H. W. Breckenridge. Skinner Chuck Co., New Britain, Conn., a complete line of lathe and drill chucks; represented by E. J. Skinner. G. T. Eames Co., Kalamazoo, Mich., compound mandrel arbor presses; represented by J. H. Penniman. The Essley company will be represented by E. L. Essley, J. R. McDonald, H. F. Roberts, C. M. Robertson, Geo. Burki, J. J. Shanahan and E. P. Essley

FEDERAL FOUNDRY SUPPLY CO., Cleveland.—Molding machines and aluminum, interchangeable, adjustable snap flasks will be displayed; represented by W. J. Adams, R. Ditty, E. Kaye and C. Berger.

FELT & TARRANT MFG. CO., Chicago.—Demonstration will be made of this company's new controlled-key duplex Comptometer adding and calculating machine as applied to book work, billing, estimating, prorating, cost calculations, etc., with special reference to problems of accounting peculiar to the metal industry; represented by W. D. Lawrence.

FLEXIBLE STEEL LACING CO., Chicago.—Steel belt lacing will be shown and the speed with which a flexible joint may be produced with no other tool than a hammer, will be demonstrated. A standard testing machine to test the strength of the belting joint produced with flexible steel lacing, will be displayed; represented by G. E. Purple.

THE FOUNDRY.—Booth will be fitted up as a rest room for visiting foundrymen; represented by John A. Penton, A. O. Backert, H. Cole Estep, A. L. Klingeman, E. C. Kreutzberg, L. C. Pelott, A. W. Howland and George H. Manlove.

GARDEN CITY SAND CO., Chicago.—Various grades of molding sands fire brick, etc., will be shown.

GARDNER MACHINE CO., Beloit, Wis.—A complete line of grinding machines and accessories, as well as a line of ball bearing polishing lathes will be shown; represented by L. W. Thompson, F. E. Gardner, E. B. Gardner, W. B. Leishman, J. M. Gardner, E. L. Beisel, A. A. Swimmerton and W. L. Townsend.

GENERAL ELECTRIC CO., Schenectady, N. Y.—Among the equipment to be shown by this company, will be an arc welding outfit of the portable type consisting of a 10½-kilowatt motor-generator set and panel mounted on a truck. The voltage impressed across the arc is varied automatically with the length of the arc. The polarities of the electrode and casting also are interchanged automatically when the function of the electrode is changed from heating the break in the casting with carbon to filling it with iron or vice versa. A centrifugal compressor with a capacity of 4,500 feet of free air per minute and driven by a 30-horsepower induction motor at 3,450 revolutions per minute, also will be exhibited. The General Electric Co. will loan to a number of exhibitors, motors for driving direct various machines used in foundry and machine shop practice. An interesting display will consist of a reversing motor-driven planer equipment. This method of planer drive has been tried out in service and some interesting records in the machining of castings have been made.

GISHOLT MACHINE CO., Madison, Wis.—An automatic vertical boring mill, tool grinder, turret lathe, small tools and an electro-mechanical time recording apparatus will be exhibited; represented by Chas. Spalding, E. A. Fuller, G. E. Gernon, J. E. Ruth, E. J. Bullard and Ellis F. Muther.

GOLDSCHMIDT THERMIT CO., New York.—Thermit cans for reviving dull iron in the ladle, making semi-steel, keeping risers liquid, etc., titanium-thermit cans for purifying iron and steel, increasing its fluidity, etc., specimen thermit welds of heavy sections including a weld of a 9¼-inch crank shaft and samples of vanadium, manganese, cobalt, chromium and other alloys will be shown; represented by H. S. Mann, H. G. Spilsbury, D. B. Browne, William Aldrich and C. D. Young.

GOULD & EBERHARDT, Newark, N. J.—Two machines will be shown in operation, including an 18 x 10-inch gear hobbing machine and a 28-inch shaper. The hobbing machine will be operated on spur gears and the shaper will plane high carbon steel.

GREAT WESTERN MANUFACTURING CO., Leavenworth, Kan.—Two styles of gyratory foundry riddles will be exhibited, one style equipped with horizontal electric motors, and the other with vertical electric motors; represented by F. A. Pickett and George W. Combs.

GREAT WESTERN SMELTING & REFINING CO., Chicago.—A display will be made of brass, bronze, German silver and other alloys in ingot form and babbit bearing metals, also solders of various compositions will be displayed. Die cast bearings and bushings and brass and bronze castings made from the ingot metal manufactured by this company also will be exhibited; represented by S. Spiro, I. N. Perlstein, A. L. Levy, Arthur Lewis, J. H. Collin and J. T. Cantor.

HANNA ENGINEERING WORKS, Chicago.—Various types of electric and pneumatic sand shakers, including the tripod, post and trough style will be shown. A feature of the pneumatic shaker that will be exhibited consists of a syphon lubricator designed for attaching to pneumatic machines of various kinds to insure uniform lubrication to all working parts through the live air ports; represented by A. F. Jensen, W. H. Huelster, J. T. Georgeson, David M. Whyte, Philetus W. Gates and James T. Lee.

HAYWARD Co., New York.—Electrically operated clam shell bucket of new design for handling foundry sand and other materials, orange peel buckets, drag scraper buckets, etc., will be exhibited; represented by H. S. Atkinson, H. M. Davison, C. S. Sargent and C. F. Hutchings.

HEALD MACHINE CO., Worcester, Mass.—A cylinder grinder, internal grinder, ring grinder, drill grinder and 16-inch rotary surface grinder will be displayed, together with a number of rotary and flat magnetic chucks which will be shown in conjunction with a special testing outfit to demonstrate their holding power; represented by J. N. Heald, C. N. Cowan, S. T. Massey and G. A. Pabst.

HENION & HUBBELL, Chicago.—A complete line of iron cement manufactured by the Smooth-On Mfg. Co., Jersey City, N. J., will be exhibited; represented by W. B. Henion, C. W. Hubbell, R. C. Mead, D. P. Toberty, W. J. Walther, W. P. Barclay and Vreeland Tompkins.

HERMAN PNEUMATIC MACHINE CO., Zelienople, Pa.—A complete line of molding machines manufactured by this company, will be shown in operation. These will include a 50 x 60-inch jar ramming machine with independent roll-over and pattern drawing device, 30 x 45 jar ramming stripping plate machine, 40 x 50-inch and 24 x 24-inch plain jar ramming machines, jar ramming machine with hand stripping device, jar ramming machines with roll-over and pattern drawing device and several small and medium size jar machines; represented by A. M. Frauenheim, Alfred Herman, M. L. Heyl, A. Rodgers, Robt. F. Ringle, A. McWithey and Joe Larson.

HILL-BRUNNER FOUNDRY SUPPLY CO., Cincinnati.—This company's space will be used as a rest room for visiting foundrymen, but in addition, a core box will be displayed and demonstrated; represented by John Hill, M. Z. Fox and C. H. Homer.

HILL & GRIFFITH CO., Cincinnati.—An extensive line of foundry supplies will be exhibited, including plumbago, core wash and core compound, parting compounds, chaplets, combination torch blacking sprayer and suction mold cleaner, as well as other foundry specialties; represented by J. M. Glass, D. T. Richards, William Oberhelman, F. McCarthy and J. H. Lyle.

HUNTER SAW & MACHINE CO., Pittsburgh.—Vanadium steel 36-inch hot saw, 44-inch high speed friction saw, Newton cold saw in operation equipped with 26-inch Hunter inserted tooth saw blade, inserted tooth grinder and saw sharpening machine, will be displayed.

IDEAL CONCRETE MACHINERY CO., Cincinnati.—Core sand mixing machines.

INTERNATIONAL ELECTRIC TOOL CO., Milwaukee.—Pneumatic vibrators.

INTERNATIONAL MOLDING MACHINE CO., Chicago.—A complete line of molding machines will be shown in operation, including a combination pneumatic and electric jar ramming machine, combination jar ramming turn-over draw machines, combination jar ramming power turn-over and power draft machines, power turn-over and power draft machines, stripping plate machines, stationary, portable power and combination jolt squeezers, as well as core ramming machines; represented by Edward A. Pridmore, W. W. Miller, D. C. Snow, J. W. Dopp, F. W. Hamel, E. M. Hays, and Carl Levahn.

INDEPENDENT PNEUMATIC TOOL CO., Chicago.—This exhibit will include piston type air drills, both reversible and non-reversible, equipped with roller bearings, Corliss valves, telescopic screw-feed, etc., portable air grinders in two sizes especially adapted for foundry use, pneumatic sand rammers, and new type of pneumatic chipping, calking and flue-beading hammers, close-corner drills, one-piece, long-stroke riveting hammers, extra small hammers for chipping and cleaning and a complete line of electric drills and grinders with direct-connected motors; represented by J. D. Hurley, H. F. Finney, H. H. Henricks, B. A. Durbin and F. J. Passino.

The Iron Trade Review.—Booth will be fitted up as a rest room for visiting foundrymen; represented by John A. Penton, A. O. Backert, H. Cole Estep, A. L. Klingeman, E. C. Kreutzberg, L. C. Pelott, A. W. Howland and George H. Manlove.

JENNISON-WRIGHT CO., Toledo.—Creosoted wood block flooring.

JANESVILLE, WISCONSIN, MOULDING SAND CO., Janesville, Wis.—This exhibit will consist of four grades of molding sand

for use in iron, malleable and brass foundries; represented by J. F. Pember.

JOHNSON, C. W., Natick, Mass.—Molders' shoes.

KAWIN, CHAS. C., CO., Chicago.—This firm of foundry chemists and metallurgists will have a booth for the convenience of its friends; represented by Chas. C. Kawin, J. F. Nellis, Wm. J. Mulcahy, R. J. Courtney and J. H. Hopp.

KING, JULIUS, OPTICAL CO., Chicago.—Eye protectors and welding helmets will be exhibited; represented by J. T. Brayton and J. J. Duffy.

KNICKERBOCKER CO., Jackson, Mich.—Dust arrestors.

LANG, R. F., New York.—Die castings produced by hydraulic pressure will be displayed; represented by R. F. Lang.

LANDIS MACHINE CO., Waynesboro, Pa.—A complete line of bolt cuttings, pipe and nipple threading machines will be exhibited, including a 1½-inch motor-driven bolt cutter, 2-inch belt-driven single bolt cutter, 2-inch and 4-inch stationary type pipe die heads and 1¼-inch automatic screw cutting die head; represented by Dorsey Thompson Jr., and Carl F. Meyer.

LA SALLE MACHINE & TOOL CO., La Salle, Ill.—A plain and surface grinder will be shown in connection with the exhibit of the Marshall & Huschart Machinery Co., Chicago; represented by F. W. Matthiessen Jr. and S. M. Trenary.

LUPTON'S, DAVID, SONS CO., Philadelphia.—A complete line of the products manufactured by this company including Pond continuous sash, sash operating devices, etc., will be shown; represented by Clarke P. Pond and Robert A. Sanborn.

McCORMICK, J. S., CO., Pittsburgh.—A sulky sand riddler, snap molder's bench, adjustable snap flask jacket and a general line of foundry supplies will be exhibited; represented by J. S. McCormick, T. E. Malone and S. R. Costley.

McLAIN'S SYSTEM, Milwaukee.—This exhibit will consist of semi-steel castings made by following McLain's system, including motorcycle, aeroplane and automobile cylinders, gears, pistons, locomotive and automobile piston rings, crossheads, pillow blocks, rocker arms, air cylinders, mold boards, plow points, crane wheels, ammonia castings, crusher jaws, dies, fire backs, propellers, pulleys, and castings for pumps, valves, machine tools, etc.; represented by David McLain, I. V. Scanlan, Harry McLain and C. W. Miller.

MACLEOD CO., Cincinnati.—Sand blast tumbling barrels, sand blast revolving table machines, portable sand blast and portable oil burners for skin drying molds and portable oxy-acetylene apparatus for welding and cutting will be exhibited; represented by Walter Macleod.

MANUFACTURERS' EQUIPMENT CO., Chicago.—Aero chucks, collapsible taps and special tools for brass and iron manufacture will be shown.

MIDLAND MACHINE CO., Detroit.—Molding machines.

MAKUTCHAN ROLLER BEARING CO., Chicago.—Roller bearings.

MARSHALL & HUSCHART MACHINERY CO., Chicago.—A large number of machine tool manufacturers will display their equipment in this exhibit. The Bullard Machine Tool Co. will show in operation a 24-inch vertical turret lathe with cutting lubricant system. The Cincinnati Bickford Tool Co. will exhibit new radial drills, as well as a vertical drilling machine with tapping attachment, positive feed, etc. The Cincinnati Milling Machine Co. will display a plain milling machine with power quick return to table, flooded lubrication of the cutter, a universal milling machine and a universal cutter grinder. E. O. Patridge will exhibit a line of grinding machines and improved emery wheel guards. Gould & Eberhardt will demonstrate a 28-inch shaper and an improved hobbing machine. The Monarch Machine Co. will show a new geared head lathe. The Rockford Drilling Machine Co. will have in operation a 4-spindle gang drill and a single spindle drill. Baker Bros., Toledo, will demonstrate a high speed drill. The Lodge & Shipley Machine Tool Co. will demonstrate a new lathe with multiple stops and new tool room lathes with relieving attachment. The Cincinnati Planer Co. will exhibit planers provided with electrical reverse and quick power traverse to the heads. The Greaves-Klusman Tool Co. will operate a geared head lathe which gives all the headstock speeds by the movement of one lever. The Acme Tool Co. will demonstrate a motor-driven 3 x 36-inch flat turret lathe. The Landis Machine Co., Waynesboro, Pa., will exhibit a 2-inch single belt-driven bolt cutter and a 1½-inch motor-driven machine. In addition, the Marshall & Huschart company will exhibit Rivett lathes and grinders and a number of Peerless drill presses, lathes, etc.

MONARCH ENGINEERING & MFG. CO., Baltimore.—An extensive line of tilting metal melting furnaces will be shown, including an oil fired furnace of the crucible type, gas fired furnace of the crucible type with combustion chamber, coke fired furnace of the crucible type equipped with shaker grate, iron pot aluminum furnace, oil or gas single chamber furnace and a reverberatory smelting and refining furnace. The stationary metal melting furnaces will include a pit drop bottom furnace of the oil fired crucible type with combustion chamber, solid bottom oil fired crucible furnace with combustion chamber, oil or gas bath tub type aluminum furnace, oil or gas babbit melting furnace, oil or gas soft metal melting furnaces and a shaker grate coke furnace for air operation. The core ovens that will be shown, include the coke, oil and gas fired drawer type, ovens equipped with overhead trolley; represented by J. J. Allen, M. W. Woodburn, J. H. Fowler and H. D. Harvey.

MONARCH MACHINE CO., Sidney, O.—In the space of the Marshall & Huschart Machinery Co., will be shown in operation a 14-inch x 6-foot standard lathe and a 16-inch x 8-foot, 8-speed all geared head motor driven lathe.

MOTT SAND BLAST MFG CO., Chicago.—The sand blast equipment manufactured by this company will be shown in operation; represented by David Mayer, E. J. Rosenthal, H. D. Gates, and F. J. Foster.

MUMFORD MOLDING MACHINE CO., Chicago.—This company will exhibit electric cam jolt ramming machines, several sizes of pneumatic jolt rammers, one of which will have in combintaion a pattern drawing mechanism, various sizes of power squeezers and split pattern machines, as well as combination jolt and squeezing machines, vibrators, hand and blow valves, etc., also will be displayed; represented by E. H. Mumford, David H. Whyte, W. H. Huelster, A. F. Jensen, J. T. Georgeson, Philetus W. Gates and James T. Lee.

NATIONAL ENGINEERING CO., Chicago.—The foundry mixers manufactured by this company will be shown in operation; represented by P. L. Simpson.

NEWPORT SAND BANK CO., Newport, Ky.—A full line of molding sand for all classes of foundry work will be displayed.

NEWTON MACHINE TOOL WORKS, INC., Philadelphia.—A complete line of power-driven saws for cutting off heads, risers, etc. from steel castings will be shown; represented by H. W. Champion, William M. Graham and James L. Scanlon.

NORMA CO. OF AMERICA, New York.—Ball bearings.

NORTON CO., Worcester, Mass.—A 2-inch Norton grinding wheel stand of a new type, and 2¼-inch grinding wheel stands of the bench type will be shown in operation. The Norton Co. extends an invitation to all other exhibitors to use these machines for sharpening tools or for any other grinding purpose during the exhibition. In addition, the company will display a large number of alundum and crystolon wheels of types suitable for foundry work; represented by Carl F. Dietz, John W. Horne and William Jove.

OBERMAYER, S., CO., Chicago.—A complete line of foundry supplies will be shown, in addition to the following equipment: Core jarring machine, electric sand sifter, Todd rumbler, rosin grinder, power sprue cutter, core oven, ladle drier, ladles, core sand mixer, sand grinder and venting machine; represented by Theodore Kauffman, E. D. Frohman, S. T. Johnston, C. M. Barker, O. J. Peterson, J. E. Evans, W. M. Fitzpatrick, F. H. Dodge, J. J. McDevitt, O. C. Olson, A. N. Wallin, C. H. Green, G. P. Peterson and J. Hoefling.

OLIVER MACHINERY CO., Grand Rapids, Mich.—Patterns illustrating the work which can be done on the Oliver universal wood milling machine will be displayed; represented by George F. Reinhard.

OSBORN MFG. CO., Cleveland.—A complete line of molding machines will be displayed.

OXWELD ACETYLENE CO., Chicago.—Blowpipes for cutting and welding metals by the oxy-acetylene process, generators and other devices of similar characer suitable for foundry use will be displayed; represented by R. R. Browning, C. K. Bryce and W. S. Hoyt.

PANGBORN CORPORATION, Hagerstown, Md.—None of the sand blast equipment manufactured by this company will be exhibited, although an extensive line of photographs will be displayed showing the sand blast equipment, sand separators, sand dryers, ventilating equipment, sand elevators, sand and dust conveyors, dust collecting equipment, moisture and oil separators, etc., manufactured by this company. In addition, drawings and illustrations will be shown of equipment covered by a $16,000 order recently placed with the Pangborn Corporation; represented by Thomas W. Pangborn, John C. Pangborn and William A. Rosenberger.

PAXSON, J. W., CO., Philadelphia.—Sand blast and sand sifting machinery, magnetic separators, molding sand and foundry supplies will be exhibited and a photographic display will be made of installations of foundry equipment, as well as the manufacturing facilities of the Paxson company; represented by H. M. Bougher, E. M. Taggart and I. F. Kremer.

PEERLESS PARTING CO., Ottawa, Ill.—Parting compound, white silica sand, various grades of ground silica and tripoli, as well as other minerals; represented by C. A. Hupp.

PICKANDS, BROWN & CO., Chicago.—A space 40 feet long and 15 feet deep reserved by this company will contain a reproduction of the Panama canal built of Solvay coke, on the scale of one-half foot to the mile for length and 1 foot to 100 feet in height. On one bank of the canal will be shown a profile of the location as it existed when the French first commenced operations. The various sections of the canal will be plainly and clearly formed and the canal bed will be filled with water. A pocket map showing new trade routes through the Isthmus as compared with the old Straits of Magellan route

will be distributed; represented by J. A. Galligan.

PREST-O-LITE CO., Indianapolis. — Two complete welding and cutting outfits, oxygen cylinders of 100 and 300 cubic foot capacity, welded metal parts, etc., will be displayed. An operator will be on hand to perform welding and cutting operations and to demonstrate the portability, convenience, economy and simplicity of oxy-acetylene cutting and welding apparatus; represented by W. H. Adkinson.

PRIDMORE, HENRY E., Chicago.—A complete line of molding machines will be shown in operation, including the following types: stripping plate, rock-over drop, power squeezer, plain electric-driven, jar ramming combination, electric jolt ramming rock-over drop, electric jolt stripping plate, power ramming stripping plate, hand squeeze stripping plate, combination electric jolt and power rock-over drop; represented by Mrs. E. M. Pridmore, H. A. Pridmore, D. F. Eagan, C. H. Ellis, A. V. Magnuson and T. J. Magnuson.

REEVES PULLEY CO., Chicago.—Variable speed transmission, wood split pulleys, commercial line shaft, ball and roller bearings and other various transmission appliances, will be displayed; represented by M. O. Reeves, G. L. Reeves, D. E. Lewellen, C. L. Irwin, W. A. Richards and A. E. Shibley.

RICHMOND STAY-BOLT DRILLING MACHINE MFG. CO., Richmond, Va.—A Richmond 12-spindle semi-automatic stay-bolt drilling machine will be shown in operation. This machine, it is said, drills 2,500 bolts in 10 hours; represented by Anson W. Richards.

RIVETT LATHE & GRINDER CO., Boston, Mass.—Two bench lathes and one radial grinder will be shown. This exhibit will be in the space of the Marshall & Huschart Machinery Co.

ROBESON PROCESS CO., Pennington, N. J.—"Glutrin" will be exhibited and the booth of this company also will be fitted up as a rest room for the convenience of visiting foundrymen; represented by D. S. Robeson, W. E. Baird and F. J. Ryan.

ROCKFORD DRILLING MACHINE CO., Rockford, Ill.—This exhibit will include a four spindle 14-inch manufacturers gang drill, a 23-inch Star lever heavy duty type upright drilling machine, and a 14-inch upright tapping machine.

ROGERS, BROWN & CO., Cincinnati.—This exhibit will consist of pig iron, coke ferro-manganese, fluor spar and castings made from the company's product, which include 65 different brands of pig iron; represented by E. L. Billingslea, L. C. Armour and H. B. B. Yergason.

S. F. K. BALL BEARING CO., New York.—A ball bearing hanger frame carrying shaft hangers, post hangers, rigid pillowblocks, pedestal pillowblocks, etc., will be shown in operation driven by a 1/10-horsepower motor. This exhibit will be arranged so that the shaft may be bent, by means of a system of levers, without binding the self-aligning bearings; represented by Messrs. Castino, Dunning and Farr.

SAND MIXING MACHINE CO., New York. — Two types of self-propelled sand-cutting machines, electrically driven, will be shown in operation. These machines are employed for cutting molding sand, and also are used in many shops for mixing core and facing sands; represented by V. E. Minich, William A. Heartt, Hutton H. Haley, John Bradley and Charles L. Benham.

SHEPARD ELECTRIC CRANE & HOIST CO., Montour Falls, N. Y. — This exhibit will consist of the following equipment: A cage controlled electric traveling hoist, monorail type; a 5-ton electric traveling crane trolley; a high lift type direct current hoist of one ton capacity, an alternating current I-beam hoist of one ton capacity, a back geared motor with winch head attached, as well as gearing which enters into the construction of these machines; represented by F. A. Hatch, R. H. McGredy, W. B. Briggs and N. Prakken.

SKINNER CHUCK CO., New Britain, Conn.—The exhibit to be made by this company will include a complete line of lathe, drill and planer chucks, drill press vises, face plate jaws, center arbors for drill chucks, universal and combination chucks, geared scroll chucks; represented by H. G. Hancock.

SLY, W. W., MFG. CO., Cleveland.—A full line of casting cleaning machinery will be shown, including tumbling mills, sand blast equipment, cnider mills, dust arrestors, etc.

STEVENS, FREDERIC B., Detroit. — Samples of facing mill products, buffing compositions and a model Stevens warehouse will be shown. The booth will be fitted up for the reception of visitors; represented by Frederic B. Stevens, W. J. Cluff, J. F. Hughes, J. M. Johnston, A. T. Wagner, J. M. Mayers, D. D. Baxter, Ward H. Dean, Harry T. Taylor and L. C. O. Smith.

STERLING WHEELBARROW CO., West Allis, Wis.—A complete line of rolled steel flasks, wheelbarrows, trucks and other foundry equipment will be displayed; represented by I. R. Smith, H. H. Baker, E. W. Sample, J. M. Dickson and J. J. Coyne.

SUPERIOR OXYGEN CO., Pittsburgh.—An oxy-acetylene outfit will be shown.

SULLIVAN MACHINERY CO., Chicago.—This exhibit will consist of three air compressors, as follows: One angle compound belt-driven 2-stage machine, which will be operated and will supply air at 80 pounds pressure for the use of other exhibitors. The rated capacity of this machine is 628 cubic feet of free air per minute and it will be operated by a belt from a 100-horsepower General Electric motor. The second machine will be of the straight line single stage steam driven type and the third will be a belt-driven enclosed single stage type with automatic splash lubrication and unloading device. Photographs of the foundry operated by the Sullivan Machinery Co. at Claremont, N. H., and air compressors will be shown; represented by Howard T. Walsh, William P. J. Dinsmoor, Edward T. Almy, J. C. West, F. R. Alger, F. H. Hoge, H. M. Boice and S. B. King.

TABOR MFG. CO., Philadelphia.—An 8-inch power squeezer, a 10-inch power squeezer, a 10-inch jarring squeezer, an 18-inch roll-over machine, a 14 x 16-inch power squeezing split-pattern machine, a 3-inch jarring machine and a 4-inch jarring machine will be exhibited; represented by Wilfred Lewis, H. K. Hathaway, H. W. Brown, J. T. Ramsden, J. H. Coleman, G. B. Hastings, Dudley Willcox, H. W. Impey, D. J. Martin and John Fender.

TITANIUM ALLOY MFG. CO., Niagara Falls, N. Y.—Ferro-titanium will be displayed and samples of iron and steel products made by the use of this alloy will be shows.

UNITED STATES ELECTRICAL TOOL CO., Cincinnati.—A complete line of portable electric tools will be shown in operation; represented by the Schneider Sales Co.

UNITED STATES GRAPHITE CO., Saginaw, Mich.—Graphite products for foundry use.

VANADIUM STEEL CO., Pittsburgh.—Ferro-vanadium and vanadium steel products will be displayed.

VROOMAN, H. S., Chicago.—A sand screen of an unusual type will be shown operated by a ¼-horsepower direct or alternating current motor. The machine is equipped with four sets of heavy steel wire metal bound screens of different mesh. The machine is portable and can be converted from a screening to a separating plant; represented by H. S. Vrooman and H. S. Vrooman Jr.

VULCAN ENGINEERING SALES CO., Chicago. — The products of the Q. M. S. Co. and the Hanna Engineering Works will be exhibited, including a cold metal cut-off sawing machine, air hoists and trolleys, pneumatic sand shakers, etc.; represented by J. T. Georgeson, W. H. Huelster, David M. Whyte, A. F. Jensen, Philetus W. Gates and James T. Lee.

WALLACE, J. D., Chicago.—The Wallace bench planer will be shown; represented by J. D. Wallace and Clifford Landis.

WARNER & SWASEY CO., Cleveland.—This machine tool exhibit will be shown in operation and will include a universal turret screw machine, a universal hollow hexagon turret lathe and an 18-inch brass turret lathe. The universal turret screw machine is equipped with power longitudinal feed for the carriage. The feeds for carriage and turret are independent, thus making it possible to use any feed that is best adapted for either member; represented by A. C. Cook, H. E. Witham, E. C. Neubert and Leonard K. Goss.

WERNICKE - HATCHER PUMP CO., Grand Rapids, Mich.—A new rotary air compressor of the single stage type with a displacement of 100 cubic feet per minute direct connected to a high speed electric motor and provided with automatic electric control, will be shown in operation, pumping air to pressures up to 100 pounds per square inch; represented by Wm. A. Hatcher, W. R. Harvey, N. M. Abernathy, J. F. Wernicke and L. C. Rahn.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh.—A complete arc welding outfit will be shown in operation and its application for welding various metals will be demonstrated. In addition, a number of electric motors adapted for various industrial applications also will be exhibited.

WHITING FOUNDRY & EQUIPMENT CO., Harvey, Ill.—The operating exhibit to be made by this company will consist of a 5-ton, 2-motor electric crane trolley mounted on a structural steel frame, and other equipment to be shown will consist of a 30 x 48-inch spur geared tumbling barrel, and section of a standard drawer type core oven and a flat top turntable 72 inches in diameter. In addition, photographs will be displayed of various kinds of cranes and equipment, as well as drawing of typical foundry layouts, etc.; represented by C. A. Hardy, R. H. Bourne, P. A. Dratz and R. E. Prussing.

WILLARD MACHINE & TOOL CO., Cincinnati.—Machine tools.

WILMARTH & MORMAN CO., Grand Rapids, Mich.—A motor-driven wet surface grinding machine, a motor-driven universal cutter, reamer and tool grinder, a combination cutter, reamer and drill grinder and two plain drill grinders will be exhibited in operation. The universal cutter, reamer and tool grinder is a new machine. A combination wet tool and drill grinder and several styles of plain drill grinding machines arranged for belt drive also will be shown; represented by S. Owen Livingston, E. T. Gorham and H. L. Saunders.

WOODISON, E. J., CO., Detroit.—A general line of foundry supplies, facings, etc., will be shown as well as the "Galvarim" riddle with adjustable bottoms and all steel vibrators; represented by E. J. Woodison.

WYOMING SHOVEL WORKS, Wyoming, Pa.—This exhibit will consist of all styles and patterns of shovels, particularly those adapted for foundry use. Shovels manufactured from Mayari steel will be exhibited for the first

time. The blade of this shovel is made from nickel-chrome steel, especially rolled for the Wyoming Shovel Works. Also a special handle will be exhibited, known by the trade name of Dirago. The grip is a malleable casting to which the handle is attached by means of a bolt extending through the entire casting and riveted on either side. In addition, the two sides of the handle are firmly seated in the casting, thereby insuring firm construction. The handle is well adapted for ramming and is designed particularly for convenience in shoveling; represented by G. E. Geer.

WOOD'S, T. B., SONS CO., Chambersburg, Pa.—This exhibit will consist of an automatic adjustable snap mold jacket, snap flask and an automatic equalizing snap rest; represented by C. O. Wood, W. H. Fisher, George M. Naylor and Victor Lesher.

Other exhibitors include Alexander Bros., Philadelphia; J. S. McChesney & Co., Chicago; Rock Island Mfg. Co., Rock Island Ill.; Alfred H. Schutte, New York; R. P. Smith & Sons Co., Chicago; Weaver Mfg. Co., Springfield, Ill., and Frank Van Couwenbergh, Rockford, Ill.

Electric-Arc Welding and Foundry Efficiency

By W B Elliott*

IT SHOULD be the aim of every foundry manager to obtain a maximum output from a given amount of material and labor. No foundry, however, is operated at 100 per cent efficiency if defective castings are made which have to be broken up and re-melted. Of course, it is out of the question to expect the maximum theoretical efficiency in this respect, but frequently the losses resulting from the production of defective castings can be materially cut down by reclaiming the spoiled work by welding or other means.

One of the most important methods of reclaiming castings to make them satisfactory to users is welding with the electric arc. In its earlier stages, although the castings so reclaimed were entirely satisfactory to the user, this method could not be used economically on account of its inefficiency. In the earlier forms of apparatus, the amount of current drawn from the source of supply was greatly out of proportion to the amount used effectively. This is due to the fact that for arc welding, direct current at comparatively low voltage is necessary and since the common source of supply is direct current at a potential of 220 to 500 volts or else alternating current, it was necessary to use a permanent resistance in cases where direct current was employed or a rotary transformer if only alternating current was available.

The potential drop at the arc, for effective welding, is rarely over 60 volts. It, therefore, can easily be seen that in the case of a foundry having a 220-volt circuit, where 400 amperes are needed to do a given welding job, that 88 kilowatts are taken from the line of which only 24 kilowatts are used effectively, while 64 kilowatts are wasted with the old style outfits.

Recently, however, these conditions have been changed for the better through the development of motor-generator sets of high efficiency. In these sets, the motor is wound to suit the source of supply and the generator for a constant pressure of from 70 to 75 volts. The current from the low voltage generator is used for welding, thus increasing the efficiency of the process by about 40 per cent. The modern motor-generator set, having greatly increased the efficiency of the electric arc welding process, still greater plant efficiency is made possible because a greater number of defective castings can be profitably welded.

Progressive foundry managers have asked why it is necessary to use any resistance at all in the welding circuit and why it is not possible to do away with all abnormal losses by designing apparatus especially for arc welding, thus abandoning the standard low voltage generator.

This demand on the part of foundrymen has been met. The up-to-date arc welding generator is no longer of the constant voltage type with permanent resistance, automatic switches, etc., to reduce the voltage, but is a machine wound for a variable voltage, making it possible to weld without resistance in the welding circuit, meaning that the total losses in transformation from the source of electrical energy are not over 20 per cent for a 400-ampere outfit. It, therefore, appears that the recent improvements in the efficiency of arc welding apparatus will make it pay to reclaim many more castings than has been the case previously.

*Welding Materials Co., New York.

Car Wheel Mixtures

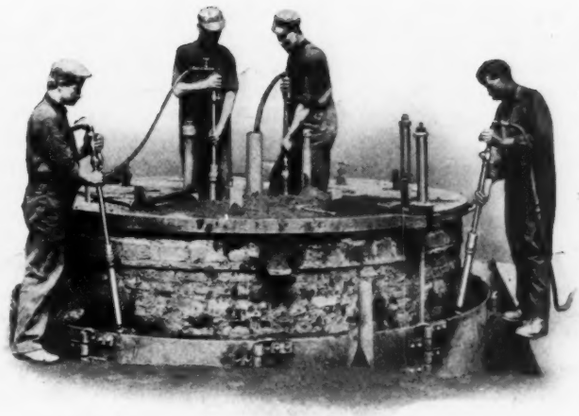
By E. H. Schwartz

In the August issue of THE FOUNDRY an exceedingly interesting article was published discussing mixtures for chilled cast iron car wheels by E. B. Tilt. The writer has studied the question of increasing the strength and wearing qualities of cast iron car wheels, and suggests that a mixture be used consisting of coke pig iron, 40 per cent; old wheels, 40 per cent and annealed malleable iron scrap, 20 per cent. After being melted and tapped from the cupola, the metal should be transferred to a 50-ton capacity oil or producer gas-fired reverberatory furnace where it should be refined for a period of one hour or more. Ferro-manganese and ferro-silicon are then added to the refined metal to the desired quantity required, and we feel certain that this mixture will produce a metal that will give a tensile strength of 40,000 pounds or more per square inch. As the result of this refining the strength of the metal will be increased, a closer grain produced and an absolutely uniform mixture will be obtained. The increased cost of refining the metal in the reverberatory furnace will be less than 15 cents per ton and this could be compensated for by the reduced cost of the mixture, as low grade irons could be employed.

New Ingot Mold Plant

The Valley Mould & Iron Co., Sharpsville, Pa., has entered into an agreement with the Pennsylvania Steel Co., Steelton, Pa., to erect a foundry for the manufacture of ingot molds at Lebanon, Pa., adjacent to the blast furnaces of the latter company. By this arrangement the Valley Mould company will use a part of the pig iron produced at the Lebanon furnaces of the Pennsylvania company. This iron is low in phosphorus and is well adapted for the manufacture of ingot molds. Heavy freight charges on shipments to the Maryland Steel Co. and the Pennsylvania Steel Co. will be saved. The Lebanon foundry of the Valley Mould company will also furnish ingots for the Cambria Steel Co., Johnstown, Pa., instead of shipping them from Sharpsville.

The new plant will have a capacity of from 75 to 100 molds per day. The contract provides that all Bessemer pig iron used at the Lebanon foundry for a period of 20 years will be furnished by the Pennsylvania Steel Co. The Valley company will continue operations at Sharpesville.



Compressed Air as an Aid to Foundry Efficiency

How Pneumatic Appliances are Used to Reduce Costs in a Large Machinery Foundry

By J Pendergast*

Fig. 1—Air Rammers Save Many Hours Labor on Big Jobs

FOR many years compressed air has been an invaluable aid to foundrymen striving for efficiency, and long before many of the modern sources of power were available, pneumatic appliances were freely employed in progressive shops. With the development of electricity and other power transmitting mediums their application has broadened rather than narrowed until today the foundries in this country are more dependent on compressed air than ever before.

In no other trade, except possibly that of mining, is air power used for as great a variety of purposes as in the foundry industry. During the past few years, the increase in the use of compressed air among foundries has been remarkable. The air compressor is now almost as essential a part of foundry equipment as the electric crane, the molding machine and other labor-saving appliances. The number of foundries equipped with air power is large and growing rapidly. An interesting feature in the use of air is the fact that, when once installed, the purposes in any particular plant, for which it can be profitably employed, seem to multiply and increase from day to day. New machines are constantly being brought forward to reduce operating costs or improve specific features of production. Visitors to the annual Foundrymen's conventions and exhibitions, during the past two or three years, must have had this fact impressed upon them strongly.

An ingenious foundry superintendent or foreman will use air in numerous home-made appliances and for purposes that occur to him from time to time, to an extent that is surprising to one not familiar with the great adaptability of compressed air.

An Interesting Example

Many interesting examples of this adaptability are found in the eastern plant of the Sullivan Machinery Co., at Claremont, N. H. An especial point of interest in this connection is the fact that one of the main products of this company is air compressors; together with compressed air, machinery of many kinds, including rock and hammer drills for mining, quarrying and contracting work; diamond core drills for prospecting; compressed air pick machines or punchers for mining coal; coal cutters operating on the endless chain principle, and driven by either electric motors or compressed air engines; heavy hoisting engines for mines; and a large variety of compressed air machinery for quarries.

This plant is situated on the Sugar river, in southern New Hampshire, the machine shop and erecting floors being on the south bank of the stream; and the foundries, pattern shops and pattern store houses on the north bank. The two are connected by a bridge, as shown in Figs. 2 and 4. The location of this plant on the sloping banks of a stream, permits an advantageous arrangement of the different branches of production, particularly in the foundry department. Fig. 5 shows the receiving and storage yard for certain classes of material, on the street level, at a point farthest from the stream and on the same level is the receiving building for coke, pig iron, scrap, etc. The charging floor for the cupolas, Fig. 19, also is on the same level, while the brass foundry, Fig. 9, and the light core-making department, Fig. 11, are on a floor above. All supplies, such as new sand, facings, daubing materials, etc., are dumped from the receiving levels, through holes in the floor, into bins directly below, which brings this material to the second, or molding floor level. The sand-mixing machinery and

*Foundry superintendent, Sullivan Machinery Co., Claremont, N. H.

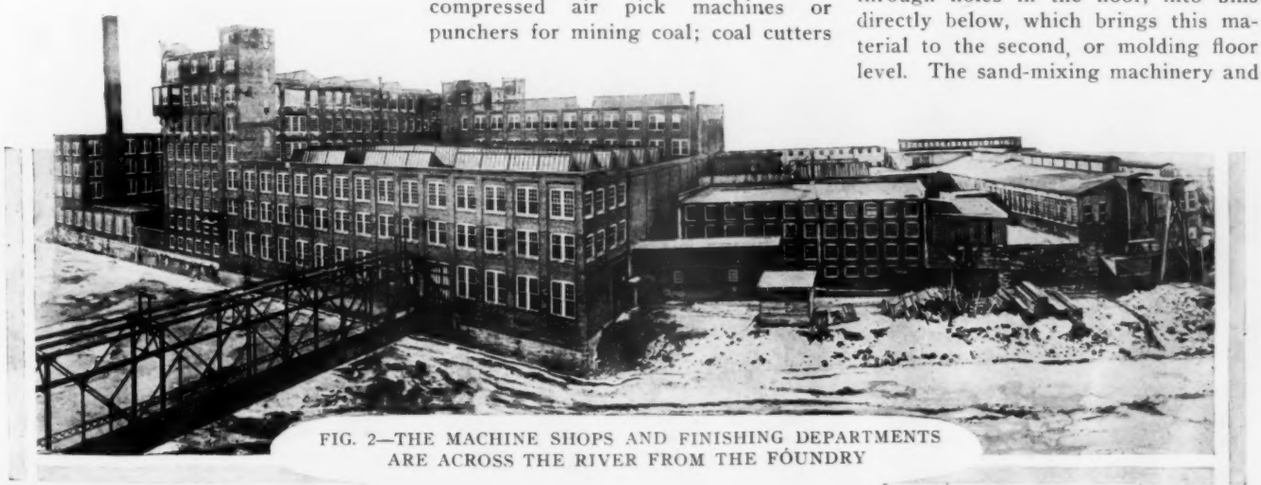


FIG. 2—THE MACHINE SHOPS AND FINISHING DEPARTMENTS ARE ACROSS THE RIVER FROM THE FOUNDRY

core room for large cores are placed close to the storage bins, thus reducing to a minimum the labor of handling sand for cores and facings. Fig. 17 shows the large core room, with the ovens and storage bins at the left.

On this same or main level is the main foundry bay, Fig. 8, 300 feet in length by 60 feet wide, where the larger castings are made; a side bay, Fig. 7, for smaller castings; and the cleaning room, Fig. 12. After the castings are cleaned, they are lowered through an opening in the floor in one corner of the cleaning room to the bottom or machine shop level, on the river bank. Many of the castings are stored in a room on this level, from which they are readily transferred, with minimum expenditure of labor and power, across the river to the machine shop. In passing, it may be noted that that location of the patterns shop and pattern store house, immediately adjacent to the foundry, and on the same working levels with it, makes for convenience in delivering patterns to the foundry, and in returning them to the storehouse when used. The main product of the foundry is gray iron castings of various grades and mixtures, although a considerable amount of small brass and composition work is handled.

The variety of work required of this plant is unusual, ranging from large, heavy castings, such as air compressor and hoisting engine frames of the rolling mill type, hoisting drums and Corliss cylinders, weighing several tons, down to small, intricate castings requiring great care and precision, such as rock drill cylinders, with long ports of air passages, gears, valve chests, air compressor cylinders, etc.

Many Uses of Compressed Air

Air power for this plant is supplied by two Sullivan compressors, one being a single-stage, belt-driven unit, located in the foundry power house, which is in the center of the plant on the main level, while the other is a cross-compound, belt-driven unit, operated from an electric motor in the main power house of the factory, immediately across the river. At present, air is used in the foundry, for operating air rammers or tampers, jarring machines, squeezers, vibrators, riddles, jib cranes, a haulage engine, a sand blast, chipping hammers, oil blow torches, general cleaning purposes, etc.

The jolt-ramming machines handle molds up to 30,000 pounds in weight. The main bay, Fig. 8, is served by two electric cranes, each of 15 tons capacity, with a 60-foot span. The jib cranes, which are located at frequent points, are equipped with compressed air hoists. One of these air cranes can be seen in Fig. 8, lowering the core into a large compressor frame mold. The cranes are supported on swiveled brackets attached to the vertical steel girders. Air hoists also are used for raising the heavy cupola doors into place. The cupolas, Fig. 16, are four in number, ranging in diameter from 24 to 72 inches. At the right of the large cupola is seen a hoist cylinder, which is ingeniously arranged to lift the bottom doors into place, after the cupola has been cleaned and daubed, ready for the sand bottom. This has proved to be a great convenience. Considerable time also is saved as compared with handling these heavy doors by hand. Furthermore, the use of the air hoist prevents the possibility of anyone getting injured while lifting the doors.

In the foreground of Fig. 8 are a number of large molds for air compressor castings. These molds are all made on a large jar-ramming machine, of 30,000 pounds capacity, operated by air power at 80 pounds pressure. The larger molds are made in dry sand and baked in large ovens in order to produce as perfect a casting as possible. Figs. 3 and 6 show a mold for a large Tangye type air compressor frame; the former illustration shows the mold on the jarring machine, and the latter shows the pattern being lifted out of the mold. The smaller molds for compressors and coal-mining machine castings are made in green sand and also are rammed on this machine. Quite frequently the cope and drag are put on the machine, side by side, and both are rammed in the one operation. Fig. 10 shows a group of castings made on this jarring machine in green sand, including air compressor frames, cylinders and intercoolers, coal machine frames, steam cylinders, flywheels and pulleys.

Numerous pneumatic riddles are used throughout the foundry, one of these being clearly shown in the center of Fig. 8. Fig. 7, as stated above, shows one of

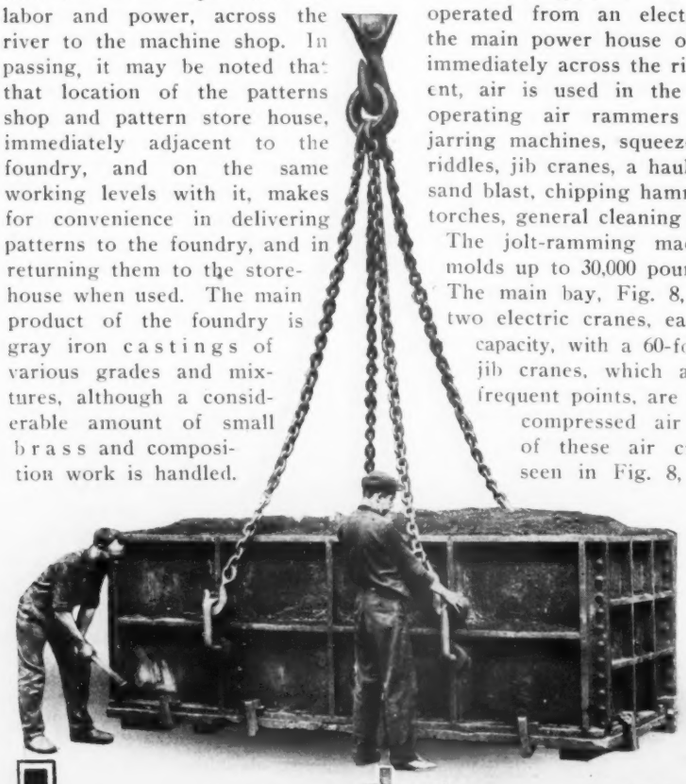


FIG. 3—RAMMING HEAVY MOLD ON PENUMATIC JOLT MACHINE

FIG. 4—FOUNDRY, PATTERN SHOP AND PATTERN STORAGE OF SULLIVAN MACHINERY CO., AT CLAREMONT, N. H.

the side floors, where medium-size castings are molded. This bay is served by one three-ton and one two-ton electric crane and two air jib cranes. At the extreme left of this picture are the benches where the small, complicated castings are made by hand. Beyond these, partly visible in the illustration, are the squeezer molding machines, operated by compressed air. These are clearly shown in Figs. 14, 15 and 17. Fig. 14 shows the operator ready to ram the cope and drag at one operation. This is accomplished by first pulling over the head of the machine into a vertical position. The lever at the right is then turned, releasing air into the cylinder below, which raises the table and squeezes the mold. A compressed air vibrator is used to rap the pattern. This vibrator is attached to the pattern plate and equipped with a knee valve, which permits the operator to use both hands to draw the pattern plate, as shown in Fig. 15.

Pneumatic Rammers Save Time

Pneumatic rammers are shown in operation in Fig. 1, which demonstrates the usefulness of compressed air in the preparation of large molds. The use of these machines results in a great saving of time, as compared with ramming one of these very large molds by hand, and also the work done by this means is more satisfactory, resulting in a more perfect casting than would otherwise be possible. The mold shown in this case is for a hoisting drum 7 feet in diameter and 7 feet in length. The completed casting is shown in the background in Fig. 13.

Air rammers also are used on other large molds that are made in pits, as well as for ramming large cores. A rammer is shown on the latter class of work in the center of Fig. 17, just in front of the large core for an air compressor intercooler on the crane. In this same illustration is shown still another application of compressed air, namely, an oil torch, used for drying cores after they have been pasted together. These torches are operated by crude oil and compressed air. Oil torches are also employed for lighting the bed in the cupola. This results in a large saving in wood, and produces a more uniform coke bed, insuring hotter iron, more rapid melting; also it eliminates almost entirely the nuisance of smoke, which cannot be avoided when wood is used to start the fire.

Figs. 12 and 13 show the two ends of the cleaning room. In the latter illustration the sand blast room and tumbling barrels are shown in the background. The larger castings are taken to the further end of this room, where all the cores are removed. The castings are next put through the sand blast, and then are carried by the electric crane to the other end of the room to be chipped. Pneumatic hammers are used entirely in this department for chipping off gates, risers, etc. The smaller castings are put through tumbling barrels, and afterward are ground on emery wheels. The air compressor cylinder head casting, which may be seen suspended from the electric crane in Fig. 12 and the castings in Fig. 10, will give some idea of the complexity of work handled in this plant.

An interesting home-made device, which has saved considerable labor and time in this foundry, is the compressed air haulage engine or winch, shown in Fig. 20. It is used for transporting heavy castings from the molding floor to the cleaning department. A track runs across the entire width of the building, and an old vertical engine and hoisting drum are used to pull the truck across the floor, as shown in the illustration.

The pipe lines for the distribution of compressed air are carried on the girders along the sides of the building and on the columns. There are numerous outlets for attaching hose for riddles, vibrators, chipping tools, and the smaller compressed air devices. A special outlet is provided, so that each crane operator may clean his crane daily by

FIG. 5—THE DIFFERENT GRADES OF PIG IRON ARE PILED SEPARATELY

FIG. 6—COMPRESSED AIR IS USED TO CLEAN OUT LARGE, DEEP MOLDS

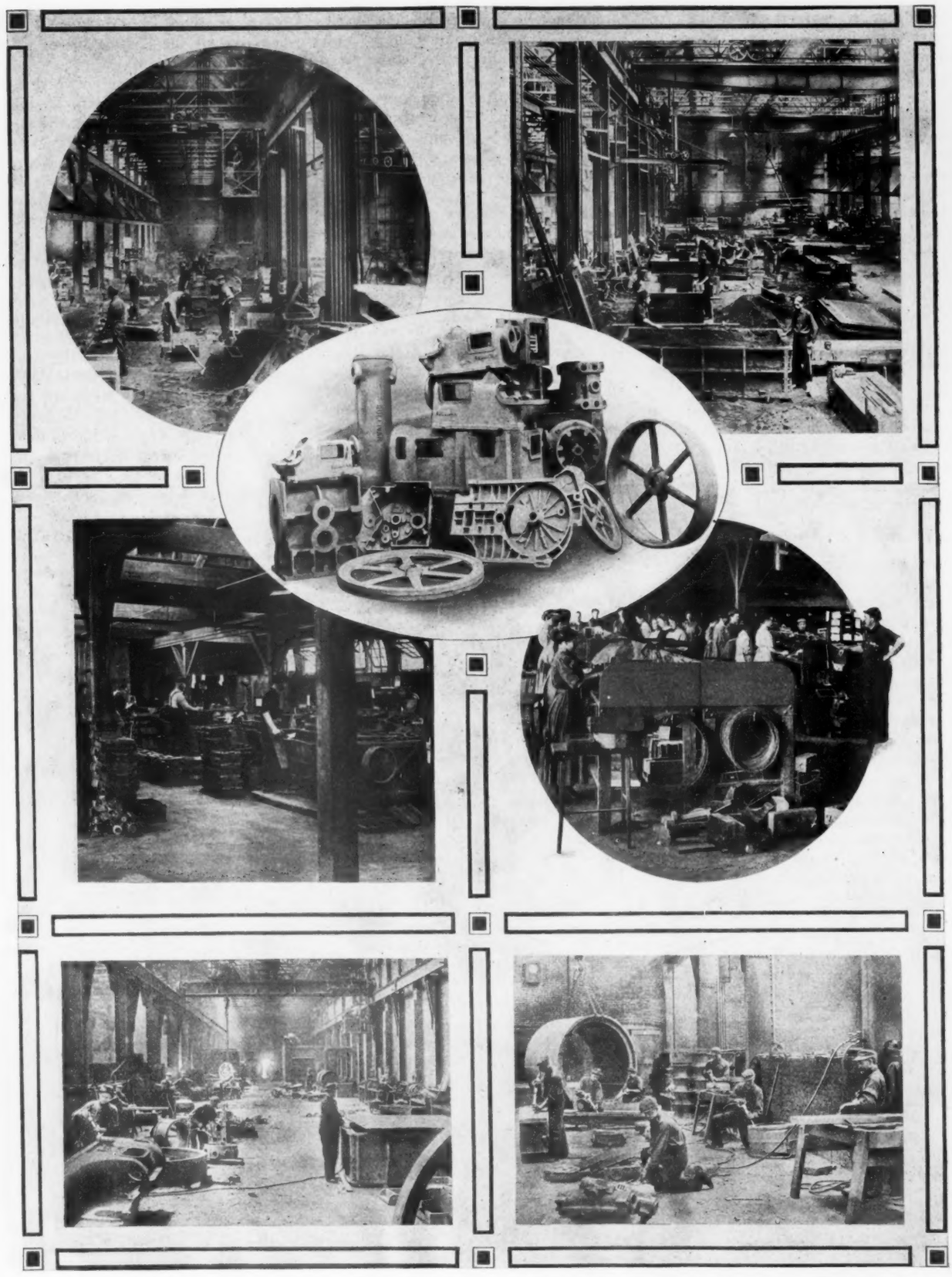


FIG. 7—AIR HOISTS SUPPLEMENT THE ELECTRIC CRANES

FIG. 8—MAIN MOLDING FLOOR SHOWING AIR HOISTS AND SAND SIFTER

FIG. 9—THE BENCH MOLDERS ARE SUPPLIED WITH PNEUMATIC APPLIANCES

FIG. 10—THE CASTINGS ARE SAND BLASTED TO GIVE A SILKY FINISH

FIG. 11—GIRLS ARE EMPLOYED TO MAKE SMALL CORES

FIG. 12—PNEUMATIC CHIPPING TOOLS ARE INDISPENSABLE IN THE CLEANING DEPARTMENT

FIG. 13—FINISHING CASTINGS WITH COMPRESSED AIR TOOLS

FIG. 14—SQUEEZING A SNAP FLASK WITH COMPRESSED AIR

FIG. 15—DRAWING PATTERN WITH AID OF PNEUMATIC VIBRATOR

compressed air. This removes the dust that accumulates on the machine, resulting in a big saving in the cost of repair parts. It will be seen from the foregoing description that compressed air is an important factor in the efficient operation of this plant.

It may be interesting to point out, in closing, some features of Sullivan foundry practice aside from the use of compressed air. As previously stated, the variety of purposes for which castings are required is large, so that different mixtures are in continual use. Each carload of pig iron, coke, etc., is carefully numbered to distinguished it from other shipments and samples are taken for analysis. The mixtures are made up by analysis and test bars are cast periodically in order to check up the physical characteristics of the metal. All material is carefully weighed out on the charging floor according to the calculated mixtures and in harmony with the specifications for each class of work. Only the best grades of pig iron, coke and scrap are used in these mixtures. All cylinders, hoisting drums and gears are made of semi-steel and are cast chiefly in dry sand or loam. Old bricks, taken from the cupolas are ground up and used with clay for daubing purposes. Fig. 16 shows the trolley on which molten metal is distributed over the molding floor from the cupolas. This trolley runs around the walls of the whole plant, to the several floors and benches, and each ladle follows a distinct route or circuit to avoid confusion and danger. The hand ladles are filled from the

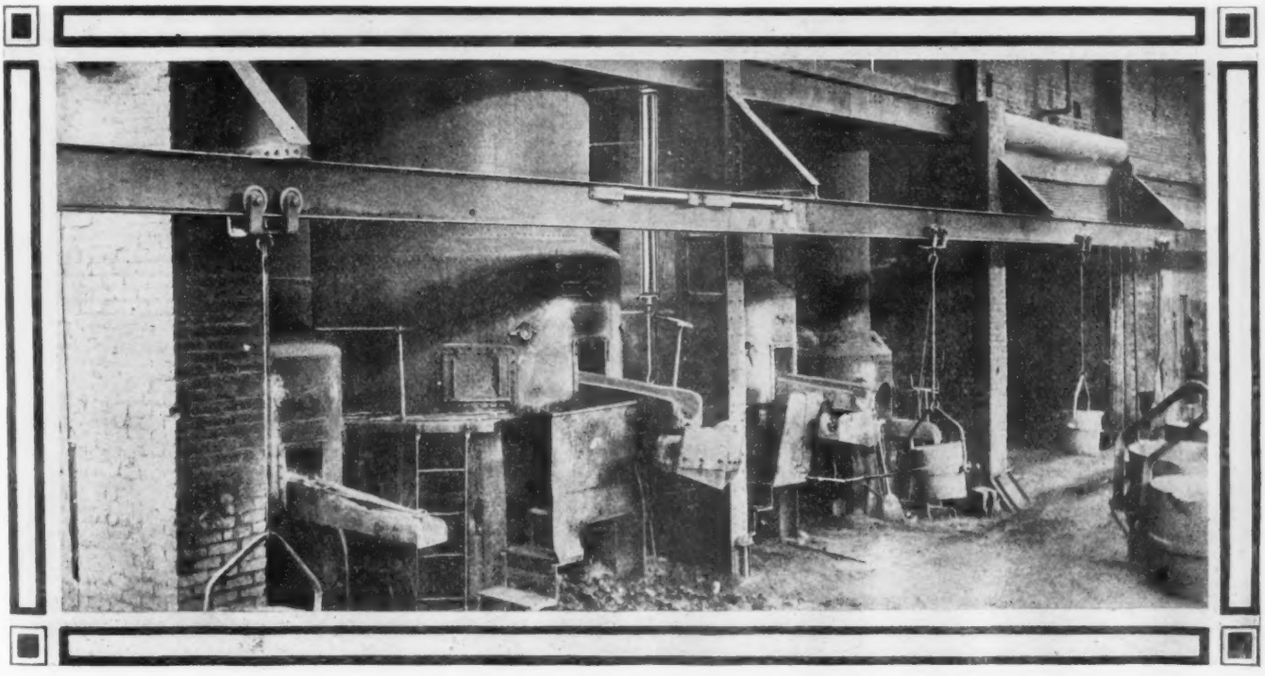


FIG. 16—A PNEUMATIC HOIST HANDLES THE HEAVY BOTTOM DOORS IN THE CUPOLAS

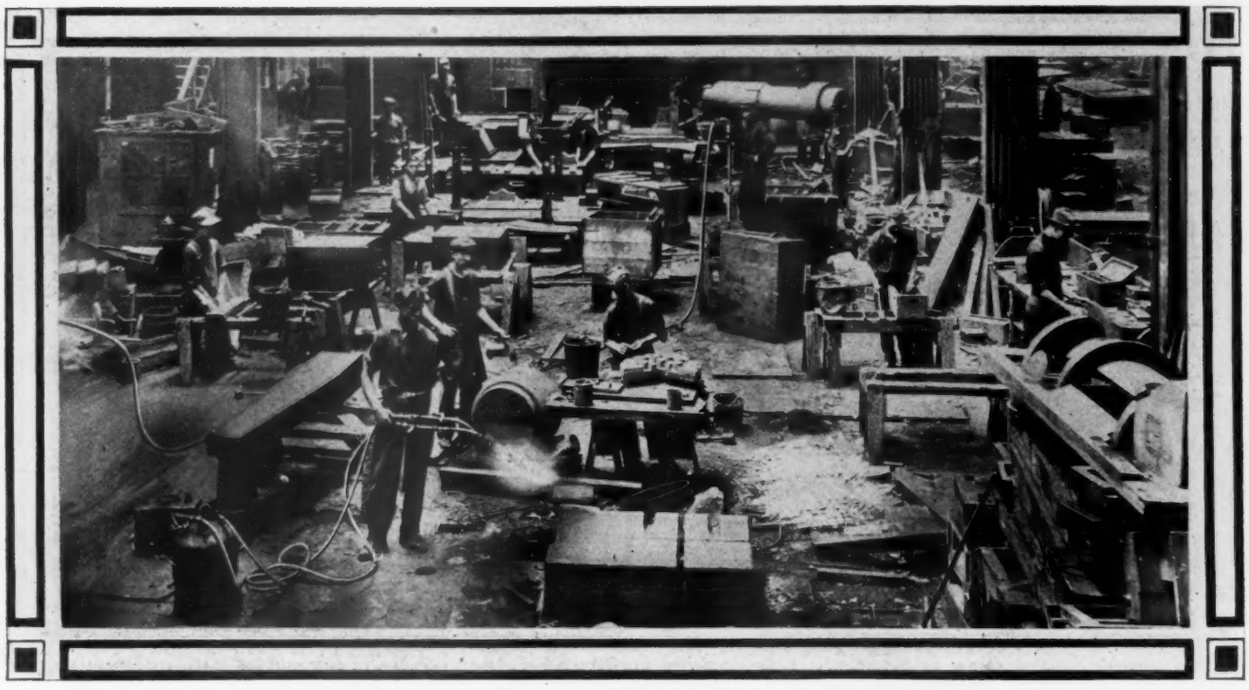


FIG. 17—COMPRESSED AIR IS USED FREELY IN THE CORE DEPARTMENT

large trolley ladles. "Safety First" is a watchword in this foundry, as well as in other portions of the plant. Railings and gates supplement danger signs where they are needed; guards are placed over grinders and other similar tools, and the molders are obliged to wear Congress shoes that may be kicked off easily if necessary. The shoes are bought in quantities and are sold to the men at low prices. Goggles are universally worn by the men handling pneumatic tools.

Life of Cupola Lining

By W. J. Keep

Question: — Occasionally one hears a statement of the large number of heats made from one cupola lining and what we would like to know is how this is accomplished. Recently we noted that one foundryman obtained 429 heats from one lining and the total iron melted aggregated 12,775.75 pounds. We cannot do anything like this, and if there is any method by which this can be accomplished, we would like to have the secret. We melt 30 to 35 tons daily at a melting ratio of 9 to 9.30 to 1.

Answer: — Your melting ratio is good, although with all machinery castings you should do 10 to 1 or better. It is safer to keep below the danger limit than otherwise, as the saving in coke would be lost if the iron should be dull in one heat. The 429 heats referred to show an average of 30 tons each. The form of a cupola lining has something to do with

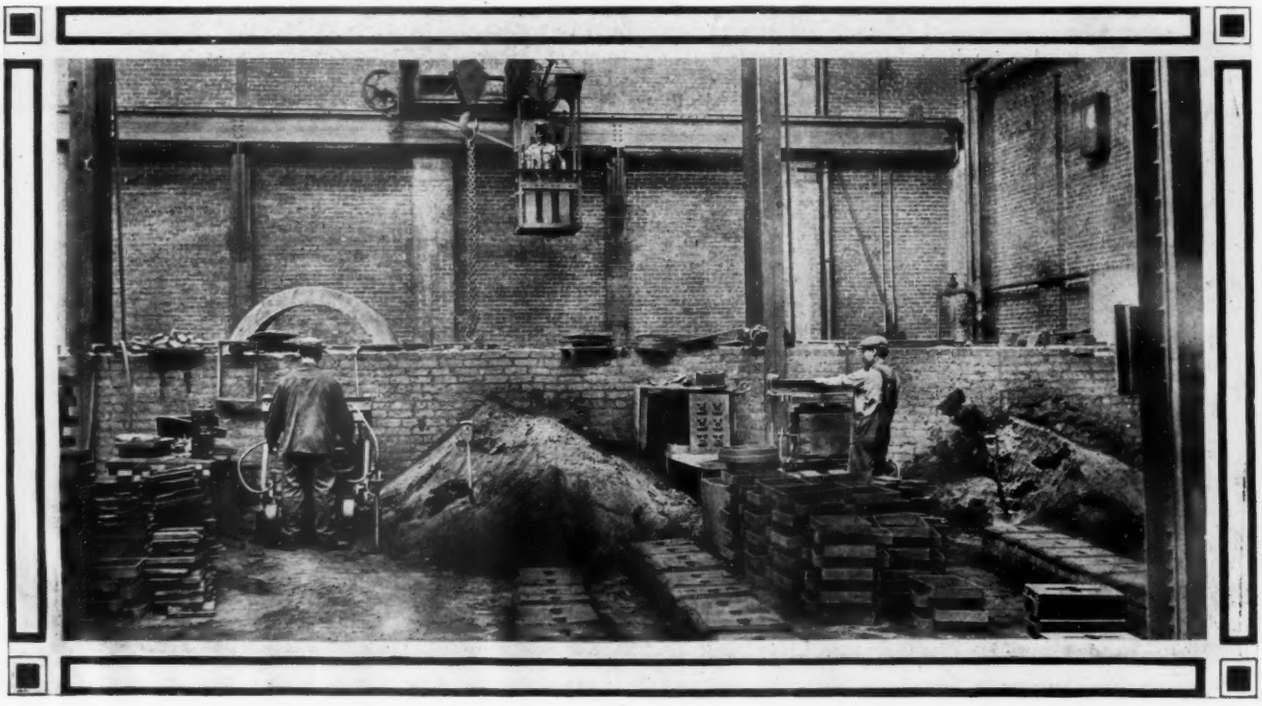


FIG. 18—MOLDING SNAP FLASKS ON SQUEEZER MACHINES WITH THE AID OF COMPRESSED AIR

FIG. 19—THE CHARGING FLOOR IS AMPLE IN SIZE

its lasting qualities. It is safe to state that a lining will last until it wears out from the abrasion of the iron rubbing against it, from the charging door to the tuyeres, or until battered out in charging. Holes will be cut in any lining around the melting zone and these should be chipped-out to take a full size piece of brick and should not be merely daubed with clay and filled-in with a splinter of

With daily patching and by using very little daubing, the lining should last unti lit is worn out by the abrasive action of the charges. The lining below the tuyeres is not subjected to wear, but on account of the heat from the molten iron, it cracks into pieces as small as gravel. These, however, will hang together until the lining is disturbed.

Appoints Panama Agents

The Terry Steam Turbine Co., Hartford, Conn., has appointed Fidanque Bros. & Sons, 15 Whitehall street, New York City, sole agents for the Republic of Panama and the Canal Zone. The Cleveland office of the Terry Steam Turbine Co. in charge of L. G. Finlay recently was removed from 710 New England building to 503 Union building.

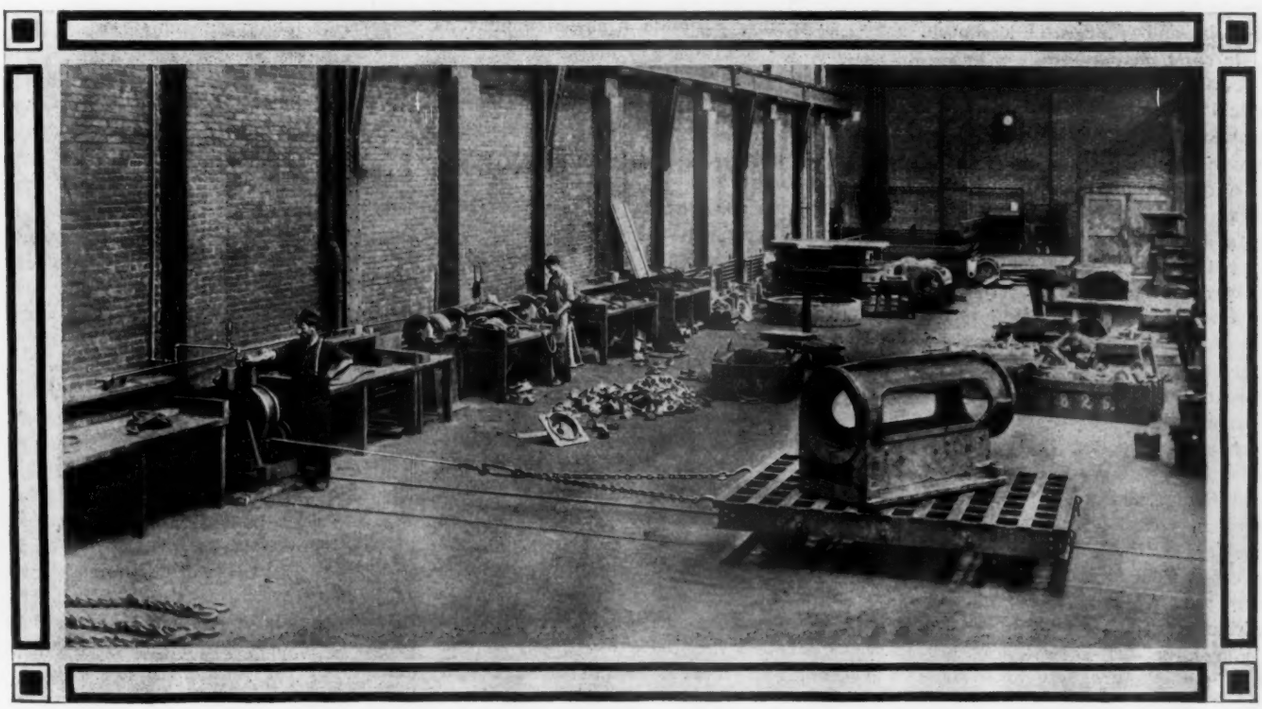


FIG. 20—A PNEUMATIC WINCH IS USED FOR HAULING TRUCKS LOADED WITH HEAVY CASTINGS

Current Foundry Inefficiencies and Practices

A Survey of the Foundry Field Pointing out Pitfalls that the Progressive Manager Seeks to Avoid

By C E Knoeppel

UNDER the caption "A Sinister Record," THE FOUNDRY, in May, 1909, stated editorially—Figures compiled by a jobbing foundryman, statistically inclined, and located in a leading iron and steel center, indicates that the business in which he is engaged is an exceedingly precarious one. During the past eight years he has kept a record of the failures as well as the number of concerns that have been engaged in this line of work, but have discontinued for various reasons. The figures are startling as they show that no less than 47 gray iron foundries within a radius of 10 miles of his shop passed out of existence, 46 remaining to contest the field today. In this total are included reorganizations, sales of shops through court proceedings—many of the plants that originally failed to produce dividends being in successful operation at present.

An investigation of the affairs of these concerns would undoubtedly have disclosed much valuable information concerning methods that should wisely be avoided and it can safely be assumed that the rocks on which they floundered were labeled *lack of system* and *failure to ascertain accurate costs.*

As a text the above editorial is an excellent one, affording plenty of opportunities for thought. From it we have the indication that the industry is first of all a dangerous one to engage in and as well as the assumption that foundry failures have been due to lack of systematic and accurate costing. As a matter of fact any business is dangerous if it is not conducted as it should be and it does not follow that costing in itself will forestall disaster. No doubt there are many cases where concerns which have had excellent accounting methods have gone under while other concerns making little effort to ascertain costs have made a success of the undertaking.

What then is the trouble if we take, not the 47 failures in eight years within a radius of 10 miles, *but the failures in the same period of time within a radius of say* 1,000 *miles of a central point?*

Efficiency is the result of an elimination of inefficiency, once it is found. It is relative, the ratio between a possible accomplishment and the actual attainment. Right here then is the real cause of the trouble—a low efficiency, surprisingly low in the majority of the foundries and from an actual knowledge of the usual procedure, I would say that the principal causes of this high inefficiency—higher than the executive usually realizes—has been and is the lack of proper conditions and improved facilities and the failure to provide staff advice. Given these two elements and any foundry undertaking is an assured success

To those who have watched the operations mentioned, the statement that from the unloading of materials to shipment of the product, the work is a chain of preventable wastes, is not at all startling.

What is Found in Some Foundries

Let us mentally go through a foundry and see what we can discover in support of this statement. If it is in the winter time, the first thing that is liable to greet us is the fumes from a number of coke fires—inefficient as far as heating is concerned and decidedly unhealthy. When the heat is being taken off, we find it difficult to see on account of the smoke and gas all about us, the ventilation seeming to be a minus quantity. We find a flask equipment that saw its best days some little time ago, many of the flasks being so bad as to be fit for firewood only—so bad in fact that a good molder dislikes to use them for even the commonest kind of work for fear of losing what he may make in them. We see a poor lighting system, making it a difficult matter for the molder to pour-off and shake-out his work to advantage. Instead of runways, we find that the paths used by the men are full of bumps and twists, making it a hard matter to get around in the darkness, smoke and the glare of the molten iron.

We see the flasks piled in any old order, on the back of floors, in the nooks and corners while the flasks in the yard look as if they had been struck by a cyclone. Imagine the work to hunt up a desired flask? We note on our trip around that the pig, scrap, coke, sands, etc., are piled or placed almost without regard to facilitating the work of the men who must handle and use these materials.

We find in watching the melting operations—a matter of the utmost importance—that the work is left to men who do not thoroughly understand the cupola and its workings, that little care is exercised in weighing the metals, that in charging the cupola it seems to make little difference how or where the materials are thrown so long as they get into the cupola and out again as iron, be it good or poor. We see molders working on patterns in flasks larger by far than is necessary for the work, requiring considerable extra ramming on the part of the molder which means a loss of time. Or we see a molder using a flask altogether too small for the work and while he may save time in ramming, the metal may run so close to the flask as to result in its running out. The casting may be bad as a result due to short-sightedness.

We see molding machines not being used because it was found that they were not suited to the requirements, or they could not be operated successfully, or the rigging was a failure—good money and space wasted. We see scrap scattered about in every part of the shop which sooner or later will be gathered and taken to the cupola if it does not happen to get buried in the sand before it is attended to. We see the cranes making lifts while men are standing around telling stories and taking it easy, waiting until they can get the cranes for their work, when a system of air hoists and chain blocks would take care of many of the lighter lifts leaving the cranes for the heavier work. We see men unloading, stacking and placing materials with a speed that would never result in their being arrested for violating limits. We find that the sand on some floors has the consistency of grit, making it a hard matter for the molder to get a good lift, consequently he spends more time than is necessary in patching and

mending his work. The pile of castings not passing inspection and returned from customers, impresses us by its size—an expensive item indeed.

We find, if the men are working by the day, that they are not unduly exerting themselves or if on piece work, they go a certain pace and then stop for fear the rates will be cut or because the union has specified what shall constitute a day's work. We find that the shop handling and transportation is inefficient—men waiting around until what they want can be brought to them, although if the *boss* happens to be around, they will get busy at something until they can go on with their regular work.

We note in the morning that the molders are taking out the work poured the night before, removing gaggers and tempering their sand before starting the work for which they were hired. Or if the castings and flasks have been removed for them during the night, the molders temper the sand as they go along and remove the gaggers as they need them.

Inefficiency on the Foundry Floor

We see molders waiting for flasks and if they are not suited to the work, waiting until the carpenter cuts a part of the flask bar away or knocks out a bar or two to put in new bars. Or we may see a molder waiting for his pattern, or waiting until the foreman ascertains whether it is the right one or not, or the patterns may have to be sent back to the pattern shop for some repairs or if the molder attempts to make the castings from the patterns as it stands he must spend some little time in patching-up his work. Or again we see molders going after his cores and chatting with his fellow workmen on the way to the core room and back, or waiting because the cores are not quite ready, or perhaps they were neglected by the coremaker and have not been made at all, or perhaps they have been made and made wrong. We see a molder digging into the back end of his floor for gaggers and clamps and if he does not find what he wants or all that he needs, he may be seen on a borrowing expedition or he may wait until some can be brought to him from the supply—if there is one. We may see him start on a piece of work, stop and go for some sand or wait until the sand can be brought to him by one of the laborers. We also see quite a little time wasted in the morning because the new work coming in has not been handed out by the foreman to the men most competent to make it.

Out of all this confusion, this hit or miss, aim-at-the-ground-hope-to-hit-the-stars way of doing things, good castings in maximum quantities are demanded—something quite impossible. The man in charge, however, who, no matter how competent he may be cannot be in every place at once, is held responsible and because he fails to accomplish what is expected of him, is called in to a heart-to-heart talk behind closed doors. Eventually he is discharged to make way for another who in time meets the same fate and so on it goes, until the concern either wakes up or goes under.

Contributory Negligence of Management

Not a glowing description I will admit, but I have outlined conditions that exist in some form or other, in many of our foundries due to *contributory negligence* on the part of the management themselves. A workman, whether he is a molder or a machinist, is about what his environment makes him and his efficiency is usually limited by what he is given to work with and the incentive to *do things* that is furnished him. Is it any wonder then, that in the face of the conditions outlined, the molder gets careless and usually so discouraged that he lacks the ambition to put forth his best efforts or that the one in charge is reduced to a state of utter disregard as to the eventual outcome?

The great trouble is that standards have not been properly set, if set at all, or if they have been set they have not been placed high enough or no effort has been made to assist men in attempting to attain standards. Here the management is again to blame. They set a final standard as to the results that they require without any regard whatever to the number of operations which must enter into the bringing about of the final results, which if standardized and the standards attained, would mean success.

The foundry has some of the elements of staff organization, but the trouble is that it is not carried far enough. The chemist will analyze a piece of iron and point out the faults and what to do to overcome the trouble, but he may not be competent to see to it that what he suggests is carried out. The cupola may not be properly handled; blast, piping and the tuyere conditions may not be what they should be; the handling of the stock and the charging may be open to improvement and the result is dull iron and bad or hard castings. Here staff advice would be available, in not only reducing the amount of defective castings, but improving the quality of those passing inspection.

The molding machine is another example. Specialists design and improve them, but do specialists see to it that the installation and actual operation is properly looked after. At the coming exhibition of foundry equipment and supplies, a large number of molding machines will be exhibited. The best kind of sand will be used; the machines will be operated by men who thoroughly understood them; the patterns will be carefully and properly designed and as a result the machines will do good work. A foundryman cannot help but be impressed with the results that will be obtained and perhaps he will decide to install one. What happens? An attempt will be made to duplicate the conditions by those not as familiar with the working of the machine as those who designed, developed and exhibited the device; men will be put at work on the machine and lacking the proper coaching they will fail to get out of the machine what had been claimed for its author. Another sample of the failure to complete the chain.

Human Efficiency

As a matter of fact, the efficiency of the man has not been looked to with the same degree of attention as has that of the machine—the relation is all out of proportion. We have the sand blast, the fast melting cupola, excellent crane and transportation facilities, good molding machines, etc., all developed to a high degree of efficiency. Has the same efficiency been developed in the human machine? If it had, my picture would not be as bad as it is.

Here then is the solution—develop the human efficiency in proportion to the efficiency of the mechanical appliances used and the foundry as far as success is concerned will take care of itself. The field is a large and profitable one—as yet practically untouched—and the possibilities for betterment simply enormous as the foregoing has no doubt clearly shown.

In a general way, the elements that should be looked into for possible improvements are as follows:

Heating, lighting and ventilation facilities.

Hoisting and transportation facilities.

The cleaning of castings.

The flask equipment, storage, piling, etc.

The handling of patterns, storage, delivering, repairing, etc.
The arrangement of the materials as regards efficient handling.
The melting operations.
The unloading and handling of materials.
Sand, facings and miscellaneous materials used by the men.
The planning and execution of the work, dispatching, etc.
The taking out of castings, tempering sand, etc.
The records used, results accomplished.
The possibilities in—
Molding machines,
Permanent molds,
Continuous melting.

Suggestions for Improving Conditions

As an indication of what can be done in the way of bettering conditions, the following general suggestions are offered.

The pattern shop should be notified as to the patterns and core boxes wanted, as far in advance of the making as the circumstances will admit.

Patterns and core boxes should be checked before being sent to the foundry so as to insure against mistakes.

Core boxes should be sent to the core room promptly so that the cores can be made and be ready for the molder when he wants them.

Patterns should be sent into the foundry on the day previous to making; placed in racks for the men and distributed to them the first thing on the morning following; this plan to be followed during the day as new work comes in.

Patterns and core boxes should be sent to the pattern shop before being sent to the the storage, if repairs are necessary following their use.

Suitable flasks should be looked up for the new work coming in and the necessary alterations made before the work is begun. The large heavy flasks should be brought into the shop if no repairs are necessary so as to be on hand when wanted.

Flasks needing repairs following their use should be attended to before being placed away.

Castings made should be taken out at night and placed in the cleaning room; the gaggers should be removed from the sand and placed in a pile on the back end of the molders' floor and the sand tempered so that the molder, upon his arrival in the morning, will lose little time in getting to work.

Flasks not in use by molders should be taken away promptly by the laboring force.

It should be the duty of some one to keep the men supplied with the miscellaneous materials such as gaggers, clamps, chaplets, nails, sand, facing, blacking, etc. In this way the molder will not be forced to waste valuable time going after such materials.

A procedure such as outlined will improve the conditions wonderfully and if in addition we reward the workmen for individual effort, which amounts to furnishing the incentive, the result will be increased efficiency. The human element must be considered. A man will pass over the possibilities for profit if some one else receives credit for the good that is done, but once put a responsibility squarely up to an employe, with the understanding that there is something in it for him if he makes good and you get him to try—and it is the eternal try-try that counts after all—you will be surprised at the results.

Bonus can be applied to a number of the departments of the foundry business. First in order would be the molders and coremakers who would be rewarded in proportion to their individual efficiency. Then we can take the men who unload, stack and place materials and reward them on the basis of decreasing costs to handle materials. We can put on a bonus, the cupola men who break and get the stock to the cupola, those who charge the cupola and the cupola tender, on the basis of decreasing cupola labor costs. The crane men can be rewarded for attending to the wants of the molders with dispatch, on the basis of the efficiency of the molders served by the cranes. The chippers and cleaners can be rewarded on the basis of reduction in costs to clean castings, while the night men who take out the castings can be paid a bonus on the basis of the saving in this expense. General labor can likewise be placed on a bonus, in addition to the foremen who can be rewarded on the basis of the showing of their men.

What Result Would Be

The net result will be that the different forces will be working with the same end in view—cutting out preventable wastes—in other words, taking one step where two was considered sufficient before. There would be no use in standardizing the molding operations and then have the molders held up by the crane service or general labor.

Standard costs should be arranged for on the basis of increasing and decreasing tonnages, for the rise and fall of the production has an effect on the costs in itself, regardless of the other conditions. For instance, the cupola costs will increase with an increasing tonnage, but not in proportion, so that the result is a decreasing rate per ton.

Although the length of this paper renders a lengthy discussion of costing out of the question, it might be well to state that foundry costs are divided into—

Direct material cost,
Direct labor costs,
Burden costs apportionable to tonnage produced,
Burden costs apportionable to the direct labor,

which can be assessed against increasing tonnages. Suppose that the scale would be from 100 to 500 tons monthly, each 50 tons increase being taxed with its standard costs and we can at the end of any period ascertain from the standard costs detail costs corresponding to the production for the period in question, against which an attainment could be measured, thus establishing a basis for calculating efficiency and bonus reward.

Interests of the Management

Any system of betterment must consider the interests of the management and those whom it employs or the system will prove a failure. If the management can adopt some method that will give them a greater production at a lower cost and at the same time bring about a better attendance on the part of the men, a desire on their part to furnish good workmanship and a willingness to turn out a maximum production, no one need worry as to the ultimate attainment. This is what the efficiency work will do for the foundryman, for the results to the management are decreasing inefficiency, less waste and consequently greater earnings through a greater production in the same length of time, at a lower cost, while the man works to better advantage, under better conditions amid more congenial surroundings. His environment is toned up and in addition he is rewarded for using his brain to best advantage, consequently the result is a satisfied, willing worker.

The Graton & Knight Mfg. Co., Worcester, Mass., recently has established a branch at 301 Magazine street, New Orleans, La., and will carry in stock a complete line of leather belting, lace leather, belt dressing and cement. This branch is equipped to handle all kinds of repair work. The territory covered by the New Orleans branch includes the entire state of Louisiana and that portion of Mississippi.

The Value of Saving Seconds in the Foundry

The Application of Time Study and Analysis in Reducing the Costs of Bench Molding Operations

By J C Pendleton and R E Kennedy

"THE POWER to produce the results intended" is termed efficiency, and any foundryman may be efficient if his intentions are based upon systematic investigation. When the executive foundryman neglects to keep pace with modern times, he can consider himself from that time on inefficient. To be a successful foundryman, it is essential to keep in touch with all data pertaining to any branch of the art which might tend to increase output and produce quicker results at a minimum cost. Information is always obtainable, and ignorance is no excuse for poor executive ability.

As each foundry is run on a different basis, producing its own class of work in its own way, it is not always clear to the superintendent how to proceed to adopt the efficient methods he has obtained through data, and as a remedy for this we wish to introduce the value of written instructions in the form of instruction cards. As the conditions of today tend to make the use of unskilled labor more of a necessity, and as the trained men are not as abundant as in the days when the length of time required to make a mold was given little or no consideration, we find that written instructions have many values.

The time has passed when the foreman's job is simply to distribute the work, calculate the heat and maintain discipline in the shop. At present, to be sure, the men follow out their instructions in detail, and to break in the ever-changing help so much of time is taken up that the initiative which the foreman should possess for keeping in touch with the times is not exercised, and we have concluded that the instruction card is the solution for this problem.

The instruction card not only instructs the men in their work, but it causes you to make an investigation, gives you information when making estimates, brings out inefficient methods, puts your shop in order, and, if bad castings result, the blame can be placed on the man at fault. For that reason the time studies and investigations should be made by a competent foundryman, capable of foreseeing problems that may increase efficiency and eliminate lost motions.

We think it is very true that many foundrymen pay no attention to minor details and continue to plod along in a rut, unable to accomplish the best results because of the fact that they pay too much attention to the dollars, allowing the pennies to take care of themselves. To get away from that old style motive, it is necessary to study in detail the minutest operation and to systematize each step. The operator should be compelled to study the motions until he becomes efficient before receiving the regular pay rate per hour or mold.

We will take for granted that all necessary steps have been taken to

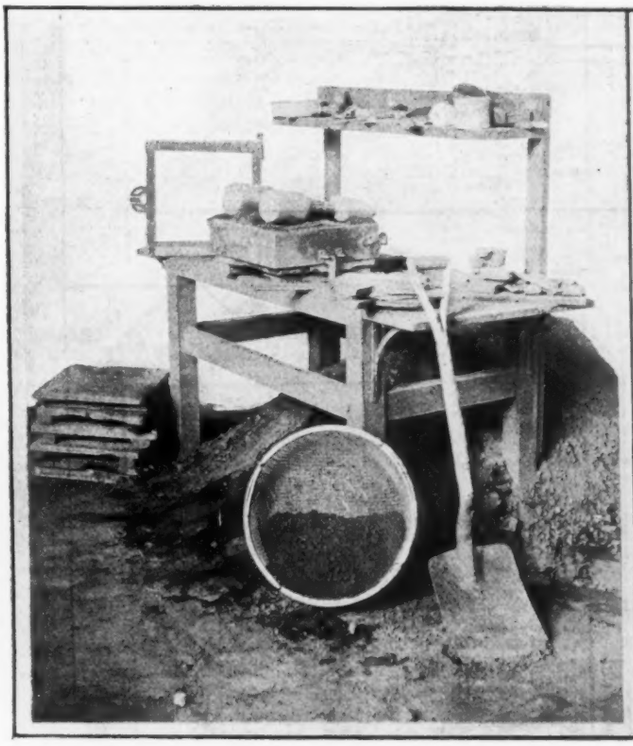


FIG. 1—AN ORDINARY MOLDER'S BENCH

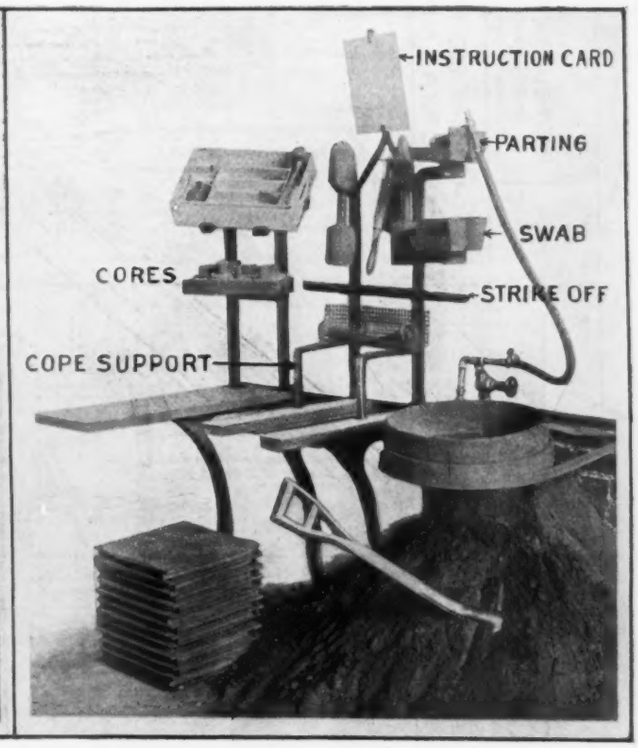


FIG. 2—MOLDER'S BENCH ARRANGED FOR EFFICIENT OPERATION

FORM 102

INSTRUCTION CARD

SHOP LABORATORIES
FOUNDRY DEPARTMENT

FLOOR | BENCH | MACHINE | STATION Cupola No 1

PART CHIPPING
ARTICLE CUPOLA PATT. NO.

STANDARD FLASK NO.	TOOL KIT NO.
SPECIAL FLASK NO	RAMMER
CORE BOX NO. / CORE PLATE NO.	FACING MXT. NO.
SAND MIXTURE NO.	TACKLE: BUCKET BU 7.1; SHOVEL SH 13.1; BAR BA 3.6; PICK PI 3.3; CUPOLA PICK; CUPOLA STAND SP.FIX.CU.I
WIRE. SIZE / RODS. SIZE	
NO. LOOSE PCS. / NO. CORES	

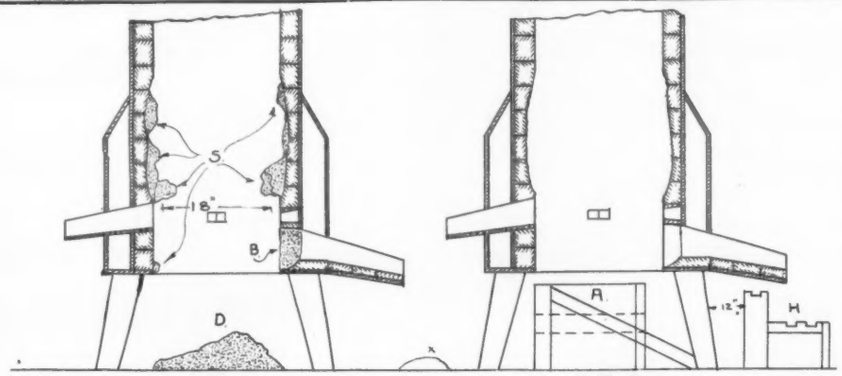


FIG. 1 FIG. 2

ITEM	OPERATION ROUTINE	STANDARD TIME MINUTES
	NOTE:-HAVE ALL TOOLS LISTED READY FOR USE AT CUPOLA.	
1.	REMOVE LADLE SUPPORTS TO POSITION 5 FT. IN FRONT OF CUPOLA. ...	0.08
2.	USE HOSE AND WET INSIDE OF CUPOLA. ...	0.01
3.	STAND AT CHARGING DOOR AND WITH BAR (BA 3.3) CHIP AWAY SLAG AS AT S, FIG. 1, TILL AN 18" OPENING IS CLEARED. ...	0.03
4.	WITH BAR REMOVE OLD BREAST AT B, FIG. 1. ...	0.25
5.	SORT OUT COKE FROM SLAG OF HEAP D, FIG. 1. ANY IRON IS TAKEN TO CLEANING DEPARTMENT. COKE IS RETURNED TO BIN NO.7. ...	0.06
6.	ALL DIRT PASSING THROUGH A NO. 2 RIDDLE IS LEFT AT POSITION X, FIG. 1. REMAINING SLAG IS PLACED IN WHEELBARROW, TAKEN TO CHARGING FLOOR AND SHOVELED OUT OF WINDOW NO. 1. ...	0.50
7.	PLACE STAND (SP.FIX.CU.I.) UNDER CUPOLA. WITH CUPOLA PICK REMOVE REMAINING SLAG TILL CUPOLA APPEARS AS IN FIG. 2. ...	0.30
8.	RETURN STAND TO BIN NO. 6. ...	0.05
9.	CLEAN UP DIRT FROM UNDER CUPOLA. PUT AWAY TOOLS. ...	0.09
10.	PLACE LADLE SUPPORTS 1 FT. IN FRONT OF CUPOLA AND 4 FT. APART AS AT H, FIG. 2. ...	0.03
	TOTAL STANDARD TIME	1.40

FIG. 3—INSTRUCTION CARD FOR CHIPPING OUT CUPOLA

FORM 102

INSTRUCTION CARD

SHOP LABORATORIES
FOUNDRY DEPARTMENT

FLOOR | BENCH | MACHINE | STATION

PART IGNITING BED CHARGE
ARTICLE CUPOLA PATT. NO.

STANDARD FLASK NO.	TOOL KIT NO.
SPECIAL FLASK NO.	RAMMER
CORE BOX NO. / CORE PLATE NO.	FACING MXT. NO.
SAND MIXTURE NO.	TACKLE
WIRE. SIZE / RODS. SIZE	
NO. LOOSE PCS. / NO. CORES	

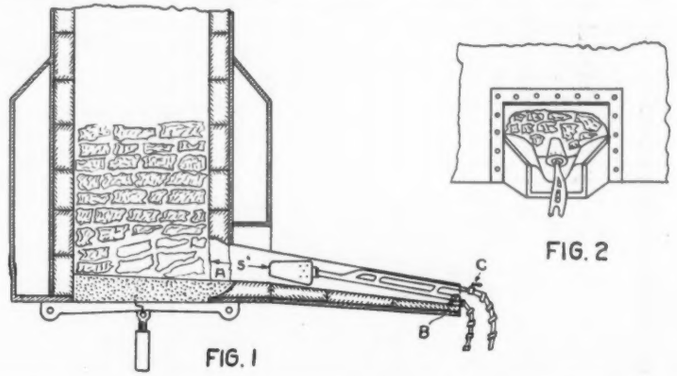


FIG. 1

FIG. 2

ITEM	OPERATION ROUTINE	STANDARD TIME MINUTES
	NOTE:-TWO HOURS BEFORE MELTED IRON IS WANTED THE CUPOLA FIRE SHOULD BE STARTED.	
1.	OBTAIN BUCKEYE BURNER NO. 2 AND ATTACH TO OIL AND AIR CONNECTIONS AT CUPOLA. HAVE UNIONS VERY SECURE TO PREVENT LEAKS. ...	0.10
2.	LAY PIECE OF OILY WASTE IN SPOUT AT POINT A. PLACE BURNER IN SPOUT AS SHOWN IN FIG. 1 AND 2. TURN ON OIL AND AIR VALVES AT PIPES ON WALL, STATION 4. ...	0.01
3.	LIGHT OILY WASTE. TURN ON SMALL STREAM OF OIL AT VALVE B, FIG. 1. TURN ON VALVE C TILL ENOUGH AIR FOR PROPER COMBUSTION IS FLOWING OUT. BLACK OIL SMOKE SHOULD NOT BE SEEN. ...	0.015
4.	WHEN BURNER IS WELL STARTED ADD MORE OIL AND AIR TILL FULL CAPACITY OF BURNER IS OBTAINED. ...	0.01
5.	WHEN COKE IS SEEN TO BE BURNING AT TUYERES SHUT OFF OIL AND AIR. DISCONNECT BURNER AND RETURN IT TO BIN NO. 6. ...	0.10
6.	RETURN TOOLS TO TOOL ROOM. ...	0.01
	TOTAL STANDARD TIME	0.235

FIG. 4—INSTRUCTION CARD FOR IGNITING BED CHARGE

prepare for the molder's day's work, as in the average shop. Our man is at a bench similar to the one shown in Fig. 1, ready to assist in making an instruction card itemizing each step.

Item No. 1.—Place 14 x 14-inch molding board in position, cleats down, cleats running parallel with bench.

Will the molder find his molding board within reach or will he have to move a bottom board to get it? The chances are that he will use several minutes looking for it. Is he going to use ten times more energy to place that board in position than he should? It is a known fact that there are only a few molders who do not work twice as hard as necessary every day, due to useless motions.

Item No. 2.—Place drag half of 12 x 12-inch flask on molding board, pins down.

It seems easy to place a drag on a board, and it is. But which is the quickest and easiest way? Will the cope and drag be together? Will he roll the flask over to grasp the drag or remove the cope and place it on top of some tools or in the way of something he will be in need of before he has use for his cope?

Item No. 3.—Place patterns on molding board in best position for gating and risering the mold.

Which is the best way to place these patterns? Who knows? The foreman may know the best arrangement for gating, but if he is not around, the man will spend considerable time shifting the patterns before they satisfy him, and even then they may be arranged so that the gating will require twice the necessary length of time. A set of instruction cards can be made that would correspond with a number of combinations to suit patterns with core prints and without core prints, having equal sections of metal. The patterns should be delivered to the molder so as to correspond as nearly as possible with an instruction card, together with an adjustable pattern gate that has been adjusted to suit the patterns by the foreman. Fig. 5 shows an instruction card purposed for that use.

Item No. 4.—Shovel sand in riddle.

Where will he find the riddle? Does the molder have to pick it up, place it on his flask, then put in a shovel full of sand? If that is the way he does it, he is wasting the company's time and his energy.

Item No. 5.—Riddle enough sand in drag to cover pattern and tuck.

Where did he place the riddle after sifting the sand over the patterns? Was there a convenient place to put it, or did he throw the excess sand back in the pile or sift it, and throw the refuse on the floor and then hang his riddle on a nail? A support similar to the one shown in Fig. 2 could be made to hold the riddle.

Item No. 6.—Fill the drag with heap sand and peen ram.

Was the operator obliged to look twice for his rammers? After he recovered them, did he ram longer than necessary? How many shovels of sand did he use to fill the drag? The number of strokes when ramming a flask means a great deal to the company and the molder at the end of a day's work.

Item No. 7.—Butt ram and strike off.

Was there more sand put in the drag before butt ramming? Were the number of strokes he made while butt ramming counted? When he struck off the drag did he use more than one stroke? Did the sand fall on the floor? If the sand is always struck off in the riddle, and the riddle placed where it can receive the sand, a large number of strokes can be eliminated through not being compelled to refill the riddle often.

Item No. 8.—Vent if necessary and place 14 x 14-inch bottom board on mold.

The venting can be questioned as to whether the mold needed it or not. Sheet iron bottom boards have proved very satisfactory, since it is unessential to leave sand on the surface of the drag for bedding on. Therefore, the time it generally takes to bed on uneven and burned wooden boards is saved. The iron boards can be depended on to remain very true to shape.

Item No. 9.—Roll drag over and remove molding board.

A proper place for the molding board is necessary and should not be far enough away to make it inconvenient for receiving the patterns when they are drawn from the mold.

Item No. 10.—Make any necessary partings and place on cope part of patterns.

As it requires strength to blow with the mouth as well as when using the bellows, an air line with an attachment is deemed necessary in our foundry and the results are appreciated. It has been found very profitable to eliminate as many of the laborious motions as possible.

Item No. 11.—Cover mold with parting sand or dust and place on cope.

The man should be able to place his hand on either the cope or parting without looking. The bench in Fig. 5 shows a suitable rest for a parting bag or container.

Item No. 12.—Place sprue and riser pins in position.

We found that it would be convenient for the molder to have a place to put his sprue and riser, and a wire basket was found to be specially suitable for this purpose, as it allows the sand to sift. The basket is placed as shown in Fig. 2. The pins are always put in place, as it is the simplest motion the molder can make. The sprue should be of a certain length or it will interfere with striking off the mold with one motion when the riser is not in use.

Item No. 13.—Riddle enough sand into the cope to cover patterns. Tuck.

Enough sand should have been in

Instruction Card

STANDARD OPERATIONS FOR BENCH MOLDING
STANDARD FLASK NO. 145. COMBINATION NO. 1.

Item.	Operation Routine.	Standard time, minutes.
1.	Put one Sh. 1 full of sand in the Ri. 6 and Riddle enough sand in the drag to cover patterns. Tuck around pattern	0.20
2.	Fill drag with 2 heaping shovelfuls of sand	0.11
3.	Use Ra. 2.1 to Peen ram using 10 strokes. Butt ram using 12 strokes	0.15
4.	Use St. 15.1 to strike off sand in riddle, using one stroke and place Bo. 16.1 on drag. Rollover	0.17
5.	Remove Bo. 13.1 and place on bench arm under core rack	0.03
6.	Place cope on and insert nail of Pi. 19.1 in hub of Ga. 16.1	0.05
7.	Riddle enough sand in cope to cover surface of drag and fill cope using 3 shovelfuls of sand	0.32
8.	Peen ram using 12 strokes. Butt ram using 12 strokes	0.18
9.	Strike sand in Ri. 6 using 1 stroke. Remove Pi. 19.1 and set cope on supports	0.24
10.	Ream out Pi. hole on joint side using Sl. 2. Remove sand from joints with air hose and place Bo. 13.1 on Ri. 6	0.35
11.	Use swab to wet around gate and patterns. Do not wet patterns or gate	0.25
12.	Use Ha. 18.1 handle and Sp. 4.1 to rap and remove Ga. 16.1. Place Ga. on Bo. 13.1 in original position. Rap and remove patterns and place on Bo. 13.1 in original position	0.60
13.	Fillet with finger where gate enters mold and remove any loose sand with the hose or Li. 3.	0.15
14.	Replace cope. Remove flask, and invert on bench arm	0.25
15.	Set mold on support to the right. Place Bo. 13.1 on bench and drag on board pins down. Clamp drag	0.15
	Total standard time	3.20

FIG. 5—INSTRUCTION CARD GIVING STANDARD OPERATIONS FOR BENCH MOLDING

the riddle to perform this operation.

Item No. 14.—Fill cope with heap sand and peen ram. Butt ram.

An enormous amount of time is saved when enough sand is put in the cope at one time to complete both the operations of peen and butt ramming.

Item No. 15.—Vent if needed. Remove sprue and cope. Invert cope to draw patterns if necessary, ream out sprue hole on joint side and remove loose sand. The sprue pin should be made so that the operator could cast without reaming out his sprue hole and a finger hold should be provided for removing it from the mold. The bench in Fig. 2 shows an arm attached for holding the cope back if patterns of intricate form are to be removed from it. If it is not necessary to invert the cope, the figure shows a rest which is the most convenient distance in front of the molder. The hose connection should be used to remove the sand from the mold, gate and riser.

Item No. 16.—Swab, rap and remove all patterns from the cope and drag. The swab should be in position similar to the one shown in Fig. 2, as it can be kept clean. When swabbing around patterns, a suitable sponge is necessary and care must be taken not to swab too near the pattern, in order to keep the pattern as dry as possible, as it requires some time to brush the adhering sand from the wet patterns before using them again. The patterns when removed from the mold may be placed on the bench arm below the cores.

Item No. 17.—Cut gate and set cores.

Fig. 2 shows the gate cutter in the tool box in full view, and not a second's thought is wasted looking for it. The cores ought to be in position as shown and in good condition. When using stock cores it is essential that the molder should do no cutting or filing. Too much attention cannot be given to cores, as the coremaker is rated lower than the molder.

FORM 102

INSTRUCTION CARD

SHOP LABORATORIES
FOUNDRY DEPARTMENT

FLOOR BENCH MACHINE STATION

PART BUILDING TAP HOLE
ARTICLE CUPOLA PATT. NO.

STANDARD FLASK NO.
SPECIAL FLASK NO.
CORE BOX NO. CORE PLATE NO.
SAND MIXTURE NO.
WIRE, SIZE RODS, SIZE
NO. LOOSE PCS. NO. CORES

TOOL KIT NO.
RAMMER
FACING MXT. NO.
TACKLE

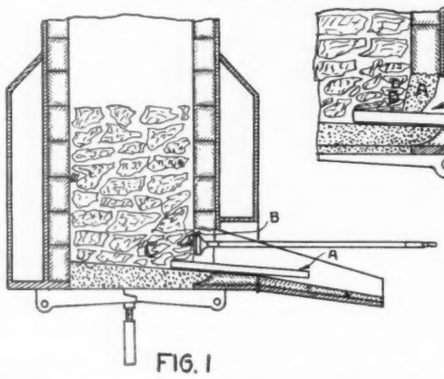


FIG. 1

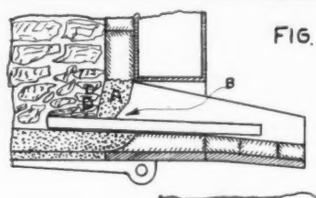


FIG. 2

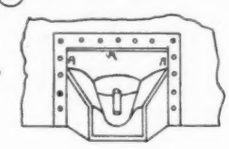


FIG. 3

ITEM	OPERATION ROUTINE	STANDARD TIME MINUTES
1.	MAKE UP SAND MIXTURE NO. 4. BRING TO CUPOLA. ...	0.15
2.	OBTAIN TOOLS LISTED. ...	0.04
3.	WHEN CORE BED BURNS THROUGH PLACE TOP HOLE BAR (BA 20.3) IN SPOUT AS AT A, FIG. 1. ...	0.01
4.	BRING 4 PIECES OF COKE ABOUT 8" LONG AND 8 PIECES ABOUT 4" LONG AND 1" THICK FROM COKE BIN NO. 7. ...	0.05
5.	PLACE LARGE PIECES IN SPACE C, FIG. 1. BED SMALL PIECES AROUND PIPE AS AT B, FIG. 1, PLACING A SOLID WALL OF COKE FOR THE CLAY TO LIE AGAINST. PACK WITH RAMMER. ...	0.08
6.	RAM SAND MIXTURE NO. 4 INTO BREAST OPENING AS AT A, FIG. 2. BE CAREFUL TO HAVE SAND RAMMED FIRMLY TO BRICK LINING AT POINTS A A, FIG. 3. ...	0.02
7.	WITH SLICK CUT FUNNEL SHAPED OPENING AROUND PIPE AS AT B, FIG. 2. SMOOTH SURFACE OF CLAY. ...	0.01
8.	REMOVE PIPE. BRUSH LOOSE SAND FROM SPOUT. PAINT SURFACE OF NEWLY LAID CLAY WITH WET BLACKING. ...	0.02
9.	PUT AWAY TOOLS AND SUPPLIES. ...	0.01
	TOTAL STANDARD TIME	0.39

FIG. 6—INSTRUCTION CARD FOR BUILDING TAP HOLE IN CUPOLA

Item No. 18.—Lead off the vent if necessary. Close the cope, remove flask and set mold on bed of sand.

It is not necessary to lead off vents from all cores, but the average molder does it because he always has, and cannot quit the habit when it is not necessary. We take care of this situation by giving each man patterns which correspond as nearly as possible. For instance, certain men are given corresponding patterns which require similar iron and leading off the vent. The molder in the average foundry, especially those working at stationary benches, before removing the first mold made from the bench, takes a shovel full of sand and after walking the full length of his floor, which averages about 30 feet, spreads the sand on the floor. One shovel full may be enough to support several molds, depending on the condition of the floor. It requires 10 seconds for the average molder to walk 30 feet with a mold and return ready to begin another. Would you consider it efficient to allow a man to spread his own sand for the molds, or to place his molds on the floor? One of the reasons for inefficient foundry management is the small amount of figuring done. To demonstrate to you the value of a second, we will use a few plain figures. The average foundry having a nine-hour work day would allow two hours for casting, leaving seven hours for molding, and allowing for 52 Sundays, 52 half days on Saturdays and five holidays, a man molds 282 days in a year, seven hours a day, averaging, we will say, 100 molds a day. The number of working days in a year, 282, multiplied by 100, the number of bench molds made per day, equals 28,200 molds per year. Seven, the number of hours per work day, multiplied by 60, the number of minutes in one hour, equals 420, the number of working minutes per day. The number of working days per year, 282, multiplied by 420, the number of molding minutes per day, equals 118,440, the number of minutes of work per year. The number of molds molded by one man in one

year, 28,200, divided into 118,440, the number of minutes worked by one man per year, equals 4.2 minutes, the time required to make each mold. If the molder is taking one second longer to make each mold than is necessary, he is wasting 28,200 seconds each year, as there are that many molds made each year. This number of seconds lost, 28,200, divided by 60, will give the number of minutes lost, which is 470. The number of minutes required to make a mold, 4.2, divided into 470, the number of minutes lost, equals 111.9, the number of molds lost per year.

A foundry with a force of 50 bench molders would lose 5,595 molds each year for every second that was wasted in making a mold. It is beyond the capacity of any human being to grasp the total inefficiency of the world.

Figures should cause any one to realize how it pays to be efficient, and some ingenious methods can be devised from time to time which will save several seconds on each mold, or several times as many as 5,595 molds per year, but the average man considers a second altogether too small a unit of time with which to bother.

The difficulty may arise that the conditions are such that to make all modern improvements would mean bankruptcy to the firm, and you will note that the bench shown in Fig. 2 shows no sand conveyor to supply the sand, neither is it portable. The man who waits for his shop to grow until all modern improvements are essential to meet the demand for his casting, will wait in vain, as it is impossible for a foundry to grow unless every effort is made to produce castings at a minimum cost so far as his foundry is concerned. The smallest foundry could install a bench similar to the one illustrated and save thousands of dollars. It is not, as a rule, the large foundries that lead in the march to success.

A Profit Loss

It has come under our observation that the majority of foundrymen do not figure the loss of a mold as the profit lost, but console themselves with the fact that as long as the iron remains the molder's time is the only loss.

He does not figure that he is losing the profit he would derive from the molds that could be turned out if he had inexperienced men to place all molds on the floor the bench molder made in a day. If you remember, we have already mentioned that it requires an average of 5 seconds to place a mold on the floor, not including the laying of the sand. These 5 seconds are equivalent to 559.5 molds per year and if fifty bench molders are at work, it equals 27,975 molds per year lost by 50 molders because they used their time to place each mold on the floor, and, if the foundry is reaping a profit of 15 cents on a mold, the loss in money per year is $4,196.25. The use of instruction cards saves amounts of this kind.

Keeping Tools in Order

Before it is possible to standardize instruction cards, it is an absolute necessity that all tools be kept in a first class condition. All draw spikes should be kept sharp, special attention should be given to riddles and care exercised to keep the meshes free from clogs of sand. Nothing should prevent a molder from having any tools he needs, as it has been proved long ago that to get the best results, the quickest way is to furnish the man tools and check them out to him; but first find out the kind of tools he needs and be sure that he has them. There are very few foundries that have what we call a tool room, but we have found it advisable to demonstrate and preach the necessity of one. All tools, except those that go in the tray may be placed on the bench or on the floor and the tool room man held responsible for their condition. They should be arranged so that the foreman could tell at a glance whether the bench or floor is ready for the molder to start ramming sand as soon as the whistle blows. All tools should have symbol numbers and in order to keep the employes from getting confused an instruction card should be placed on each side of the tool room window. Every tool should be listed on this card and the system described. There is no excuse for a mechanic cutting his sand, mixing facing, getting flasks or bottom boards before starting a day's work. In fact we can conceive no reason why any man should do anything that a lower paid man could do as well. With the information to be had pertaining to foundry management, it seems that it would be impossible to find a foundry that paid the molders 35 to 45 cents per hour for shaking out castings and cutting up sand, but upon investigation you would be astonished to learn that a great many foundries continue to follow that practice.

Cupola practice has been given more attention in the past than any other branch of founding, and some foundrymen consider it a crime to waste an ounce of coke. We dare say they are right, but if some of their energetic efforts were used to eliminate the demoralizing conditions that go with their efficient cupola practice, we believe that the production would be increased to a sensational extent.

There are some men holding what they consider responsible positions as cupola tenders who are impressed with the belief that they will carry to the grave the efficient secrets of their particular furnace. But the standardization of foundry operations and the use of instruction cards will be the means of simplifying the operating of a cupola to the extent that any man able to read can master the furnace the first day without the foreman's help.

Some of the instruction cards we have found of immense value when using an inexperienced man to make the cupola ready for the next heat are illustrated in Figs. 3, 4 and 6. These do away with all verbal instructions, allowing the instructors to give their attention to problems which otherwise would be neglected.

The time when written instructions and standardized operations are a requisite to meet competition is not far off, and the foundries which are first to initiate this system will be the most prosperous. When cupola instruction card No. 1 is given to a man who has barely seen a cupola, he asks for nothing more, and proceeds with his work, knowing what is coming next and how long he should take in each operation. Therefore, he does a good job in a reasonable length of time, and when he has accomplished all that is stated on the card he has card No. 2 in his hands.

One of the methods in use for many years to produce castings at a minimum cost is the piece work system. The average foundryman who adopts this system, and it may be either practically or impractically initiated, is willing to drift into the happy simplicity of mind that as long as his men are working piece work, the useless motions they make to construct their work is not to be considered, providing they produce a suitable casting in a reasonable length of time.

Piece and Semi-Piece Work

It is obvious that there are two different kinds of systems in vogue, namely the piece work system and, as we would term it, the semi-piece work system. The latter is the one used by the average foundry. There are very few foundrymen that work every man on piece work, although they believe that they are making every minute count to increase production and the rapidity with which the men go about their work, would cause the superintendent to assert that his foundry was faultless.

Observation is the forerunner of efficiency and the foreman who is the

closest observer is generally the most efficient.

To bring before the readers of THE FOUNDRY some of the possibilities than can be realized and to acquaint foundrymen with conditions that lie within their reach, we submit the following information taken from foundries that have installed the piece work system, some of which are considered very efficient. One of these foundries works about 70 molders on benches, and all are paid by the piece. The figures we use will be based on a visit to this shop.

Ruinous Motions

We wish to recall your attention to the man who places his molds on the floor, together with the time it takes to keep his bottom boards within convenient reach and plenty of sand always beside his bench. In this foundry every one of the 70 molders places his molds on the floor, replenishes his sand heap, keeps his bottom board out of reach so as to require turning around to get it, and indulges in a number of other similar ruinous motions.

Our previous statement was to the effect that each second employed while making a bench mold would be equivalent to 111.9 molds per year, provided the molder produced 100 molds each day of the 282 working days. If the 70 molders in the shop referred to lose 1 second on each mold, the loss is equivalent to 70 times 111.9 which equals 7,833, the number of molds lost per year. The average molder uses on an average five seconds to place each mold on the floor. The figures show that five seconds multiplied by 7,833, the number of molds lost per year by 70 men, is equal to 39,165, and if the profit should be 15 cents on a mold, the loss in dollars is equivalent to $5,874.75. To minimize this loss it would be necessary to provide each man with a support to place each mold on as it is finished. The molds should be removed by a strong laborer who should receive a certain rate of pay for each mold he sets on the floor, and to prove that this will pay we present the following.

The present average time required to make a certain bench mold equals 252 seconds. If five seconds are eliminated through the molder not having to place his mold on the floor, the time is reduced, leaving 247 seconds. If 100 molds are made each day the number of seconds saved on each molder would figure 500. As the best average time made by one molder placing molds on the floor is three seconds it is plain that if an extra strong laborer were employed for this particular job, he would have no trouble placing each mold on the floor in three seconds. If it were possible to pick 70 extra strong molders, the difference we will show would probably not be as great, but as it is more of a possibility to employ one extra strong laborer than 70 extra strong molders, the figures proceeding will show it to pay immensely.

To place a mold on the floor requires three seconds of the helper's time, to walk from one floor to the other requires one second, to place his molding boards within reach requires two seconds, and ten seconds is used to replenish the sand pile, while two seconds should be allowed for rest. The sand and boards should be within eight feet of the molder, supplied by another laborer, and this is customary in the shop referred to. To have the man back to the initial mold in time, we will divide the 18 seconds, the amount allowed for helping each molder, into 235, the number of seconds now required to make a mold, and the result is 13, the number of molders the laborer will be able to assist in molding. We find that this help will eliminate 17 seconds of the molder's time due to the fact that it requires five seconds of the average molder's time to place the average mold on the floor, two seconds to keep his board in place and 10 seconds to keep his sand pile in shape. Therefore we have the laborer saving 17 seconds on each mold. The 13 molders that had been putting up 1,300 molds would now have 1,300 multiplied by 17, which equals 22,100 extra seconds which they could each utilize in making molds, which would allow the construction of 94 molds apiece. The helper in this case would be the means of producing 94 molds each day and could be rated to receive slightly over a helper's wages. The increase in the output per year for 13 molders equals 26,508 molds, or figuring it in dollars using 15 cents as a profit, it means $3,976.20. The profit when working 70 molders is approximately $21,408.03.

How to Handle Cranes

Another of the inefficient practices we wish to discuss is the method of handling the cranes in the average foundry. Having worked in several foundries we have been forced to believe that the average craneman is the weakest element of the force. He is the man who holds in his hands the lives of his fellow workmen, and the success of the firm depends largely on his ability, but, strange as it may seem, the greatest judgment this man displays is centering the crane hook over a job or ladle, and this we all know comes through practice.

We have always observed that the crane runner is his own boss, except when the foreman is looking at him, and even then he considers that he is favoring the molder to respond to his call. Thousands of dollars are lost each year due to this individual's inability to use a little judgment.

One of the duties of the craneman with which all of you are familiar is assisting in the coring of a mold. This sometimes requires many hours, and we have always noticed that while helping to perform this operation, he will permit 5 to 10 men to stand idle rather than leave the man he is working with for 20 minutes, which in many cases is ample time to place a large check ring, or cope of a flask. If he is questioned as to why he does not assist these men he will reply that the particular mold has to be prepared for the next heat, but the chances are the job will be ready for casting a couple of hours in advance. Similar conditions as these occur many times during a day which help retard production. There are a number of superintendents and foremen who, when questioned regarding their output, excuse themselves by stating that they haven't enough cranes to handle their work, and we have visited foundries with so many cranes that they were in each other's way. In all cases, whether the shop had one or 20, the excuse was always the same, and the crane man always inefficient. Looking at it from a practical viewpoint, we would suggest that this position as crane runner be filled by a capable man who has good executive ability and can realize the importance of his position.

The rate of pay per hour for such a man should not be questioned in order to secure an efficient one. This man should be provided with information as to how to distribute his services, and it is essential that before allowing him to take full charge of the crane he be able to perform his duties to the satisfaction of an efficient foreman.

License has been granted by the Pittsburgh Iron & Steel Foundries Co., Midland, Pa., to the United Engineering & Foundry Co., Pittsburgh, for the manufacture and sale of "Adamite" rolls. The Pittsburgh Foundries company has controlled the patents on these rolls for several years and will continue their manufacture and sale. Among other improvements recently made at the Midland plant of the company was the installation of a 35-ton open-hearth steel furnace, doubling the capacity of the open-hearth department.

The Welding Materials Co., New York City, has removed from 149 Broadway to the Engineering building, 114 Liberty street, New York City.

Labor Leader's View of Scientific Management

The Danger of Modern Industrial Methods Lies in Their Repressive Influence on the Worker

By John P Frey*

IT MAY be difficult to lay down a definition of scientific management which would prove acceptable to all, and it is not my intention to attempt this, but rather to submit a brief classification of what are considered to be some of the principle features of scientific management, as presented in the books prepared on the subject by some of its best known advocates and exponents.

It would appear that scientific management aims to secure greater production from machinery and workmen,

A.—By systematizing, standardizing and overseeing all work by speed, repair inspector and gang bosses or functional foreman and over-foremen.

B.—By having time studies made with the assistance of split second watches by which to note the time consumed in performing each motion made in connection with the work.

C.—By having studies made with the object of eliminating all useless motions.

D.—By having the time to perform a given piece of work determined from the records secured.

E.—By the minutest subdivision of the specialization of work and the employment to the largest degree possible of laborers trained to work under this system rather than the employment of skilled mechanics.

F.—By the payment of a bonus or premium to workmen for measuring up their day's work to the task set and the payment of similar inducements to foremen and over-foremen for maintaining the quantity of production of the gangs of workmen or departments under their charge.

Management Not a Science

The science of managing men and directing their efforts, whether mental or physical, to secure a desired result differs widely from the accurate sciences, such as chemistry, physics, mathematics, etc. The reaction of one chemical upon another is something which can be definitely demonstrated, and the mechanical engineer works with materials which produce results with scientific accuracy. In the field of applied chemistry, or applied mechanics, the engineer works with definite knowledge. He can blend the chemicals to secure the desired reaction, and he can apply the laws of mechanics and secure definite results from machinery. But the problem of blending men in a manufacturing establishment to secure definite results is a different proposition, and no shop manager can handle the human beings under his direction with the same definite knowledge or assurance that the chemical or mechanical engineer does in his field of effort or experiment. Aside from all other factors the human one must play a prominent part in the industries.

If labor could be handled, grouped, erected, dismantled and experimented with, as can be done with machinery, one of the greatest problems which the efficiency expert has to solve would be eliminated. But labor means the service of human beings, and those who are to handle men must realize the distinction between machinery and men, for failure to do this will be invariably fatal to success.

One of the greatest scientists and educators in America, G. Stanley Hall, has said that the progress of the world has not been due to a few great thinkers, but because of the large number of thinkers, and that our present form of civilization and our industries could not make progress merely because of a few great thinkers, but depend rather upon the thinking capacity and the knowledge of the mass.

As far as labor is concerned, scientific management as advocated by some of its best known exponents seems to overthrow the entire scheme of evolution, which has developed man into a thinking animal. They divide men in industrial establishments into two grand divisions—the thinkers and the non-thinkers. The thinking and planning is to be done by groups of foremen and their superiors, and the workmen are not to be taught to think for themselves. They are merely to produce at the highest possible speed—one group, the workmen, to do the speeding, and the other, the small group, the directors, to do the thinking. It must follow that to the extent that one group in the industries does all the thinking for the other, to that degree the other group will lose its mental efficiency.

There is a wide distinction between the workman's physical efficiency and his mental and mechanical efficiency. The first relates only to the amount of physical effort which a workman can put forth within a given time, while his mental and mechanical efficiency determines the character of his product. If physical efficiency is to be the only necessary quality in order to secure the best results under scientific management—and this must be the case if different groups of foremen are to do the thinking for him—then it follows that the principles of scientific management should be carried farther, and in addition to studying the workman's movements, with the object of eliminating all unnecessary motions, a still further study should be made under the direction of scientists, so that the workman's highest capacity for physical exertion could be developed, that is to say, what diet and personal habits would give his body the greatest amount of vitality and muscular strength of which it was capable. In addition to time and motion studies it would seem that the physical or physical instructor should be called in to study each individual workman, and prescribe that diet, method of living, etc., which are necessary in order to have his vital organs produce the greatest amount of energy.

In every man there are certain major characteristics, and it is necessary to develop all of these in order to secure the individual's highest efficiency. Insofar as scientific management relates to labor it would seem that the tendency is to produce general inefficiency, and to further stunt those characteristics which are most in need of development.

Man's Characteristics and Tendencies

Dean Herman Schneider, of the College of Engineering, University of Cincinnati, one of the leading educators and prominent engineers, has, after years of studying the men who came under his observation as workmen and students, laid down the following as among each man's characteristics and tendencies:

Physical strength or physical weakness; the manual or the mental; the settled or the roving; the indoor or the outdoor; the directive or the dependent; the original or the imitative; small scope or large scope; the adaptable or the self-centered; the deliberative or the impulsive; manual accuracy or manual inaccuracy; mental accuracy or mental inaccuracy; concentration (mental focus) or diffusion; rapid mental coordination

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or slow coordination; the dynamic or the static.

The systematizing of a plant under scientific management, with its routing and planning departments, its speed bosses, etc., would tend, as far as the workman is concerned, to develop only the manual, indoor, dependent, imitative, small scope, manual accuracy and static characteristics, and would tend to stunt all of the others. The system, instead of developing the man to his greatest efficiency as a workman, must work for under development and repression.

Repression Cause of Fatigue

Biologically the greatest disorders come from repression. Repression causes fatigue. For example: Ask a highly nervous, energetic man to sit still for three hours, and at the end of that time he is fatigued, while another man of different temperament might be rested.

It is not the hours of labor altogether which determine fatigue, but rather the method under which labor is performed. Formerly, after 12 hours of labor workmen were less fatigued than they are today after 8 hours of labor, due to the fact that the method under which labor is performed today is more tiring. It is enervating and not energizing.

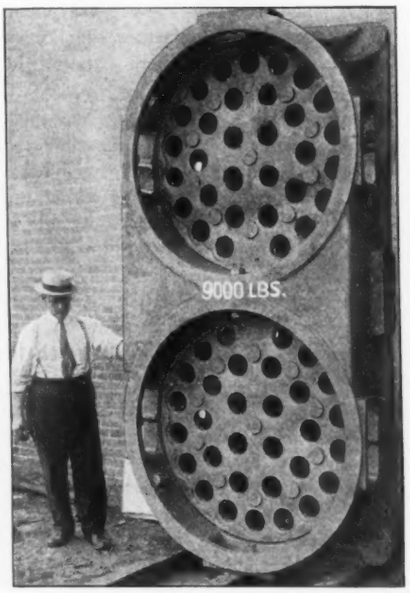
While some efficiency experts do not go to as great an extreme there are those who apparently are of the opinion that mechanical efficiency—that is to say mechanical knowledge of a trade on the workman's part—is an unnecessary factor.

While scientific management in some of its phases has entered into the most minute details, on some important factors connected with production it touches but lightly and indefinitely, while other equally important ones are practically ignored.

This is particularly true of its attitude towards workmen, the flesh and blood human beings who are to be developed into semi-automatic attachments to machines or rigid and inflexible forms of directing production, if one feature of this system is to be applied.

The efficiency of a workman is not to be determined solely by his ability to continuously feed and operate a machine or perform some other task with a never changing motion at high speed, acquired as the result of time and motion studies by those who may be employed as experts in this work. To a very large extent his efficiency will depend upon his alertness of mind and physical responsiveness, and his ability to maintain both under the numbing influence of his monotonous task.

The situation then sifts down to this: Energizing work is decreasing, enervating work is increasing; we are rapidly dividing mankind into a staff of mental workers and an army of purely physical workers, the physical workers are becoming more and more automatic with the sure result that their minds are becoming more and more lethargic. The work itself is not character building, on the contrary it is repressive and when self-expression comes it is hardly energizing mentally. The real menace lies in the fact that in a self-governed industrial community, the minds of the majority are in danger of becoming less capable of sound and serious thought because of lack of continuous constructive exercise while engaged in earning a livelihood.



LOW PHOSPHORUS LOW SILICON SEMI-STEEL CASTING WEIGHING NEARLY FIVE TONS

It has been found by experiment that when the impure forms of bauxite containing considerable iron oxide are exposed to intense heat, the bauxite is converted into a solid mass of emery which is so hard that it can barely be cut by steel tools and resists chemical, thermal, and mechanical action to a marked degree. Recent applications of bauxite in brick, according to the United States Geological Survey, are in the lining of rotary cement kilns, lead-refining furnaces, and basic open-hearth steel furnaces.

The *International Molders' Journal* states that 76,262 out-of-work stamps were issued during the first six months of 1914, which is 19,047 more than were issued during the entire year of 1913.

Solid Castings

By Paul R. Ramp

There are two important things to be considered in the production of solid castings that are required to stand a high pressure in service. One is the method of molding and casting and the other the character of the metal used. To eliminate the danger of sand holes caused by the mold cutting when the metal is poured into it, or dirt in the form of loose sand finding refuge in the various pockets of the mold, it is the best practice to make the molds for large castings of a dry sand mixture or in loam, which may be thoroughly dried. This produces a hard surface that makes it possible to place the cores without knocking off small particles of the mold, which would eventually be found in the casting.

The proper dry sand mixture will stand the heat of the liquid metal better than a green mold or than a skin dried mold and also will produce a smooth surface. The material in the dry sand mixture will expand when the metal heats it, and this has a tendency to reduce soggy spots in heavy sections.

After the question of the mold is taken care of, the metal itself must receive careful consideration. It must be melted hot if a perfect casting would be the result. For instance the 9,000-pound exhaust base shown in the accompanying illustration has been made in dry sand and poured of a special metal. In this casting there are many different thicknesses of metal and without the proper mixture soggy spots are sure to develop in the heavy sections.

The analysis of this casting was as follows: Silicon, 1 per cent; sulphur, 0.09 per cent; manganese, 0.80 per cent, and phosphorus, 0.35 per cent. The low silicon helped to close the grain of the metal. The low phosphorus played a very important part by allowing the heavy sections to solidify more quickly than in an ordinary metal, which reduces the quantity of graphitic carbon produced. While the low phosphorus metal may not flow into the various crevices and light sections as readily as it would if a metal higher in phosphorus was used, its value can hardly be disputed when the question of making a casting with irregular sections that must be free from soggy spots. It is, of course, necessary to melt this kind of a mixture much hotter and pour it much hotter than ordinary gray iron to obtain the required results.

Modern Two-Story Foundry for Pipe Fittings

Plant of General Fire Extinguisher Co. Providid With Special Sand Handling, Melting and Molding Equipment

OTHER things being equal, the ordinary one story one-heat-a-day foundry cannot attain the efficiency of the two story continuous or semi-continuous plant in handling certain classes of light repetition work. This applies particularly to the manufacture of cast iron pipe fittings, valves, etc. If the economies of the two story shop are combined with those which result from a thorough subdivision of labor brought about by a careful organization of the plant into departments, and at the same time the quality of the product is maintained at the highest point by a system which promptly and effectively fixes the responsibility for spoiled work, operating efficiency approaches its maximum.

That this must be true is evident from a study of the shop of the General Fire Extinguisher Co., Providence, R. I., where the conditions and principles suggested in the foregoing paragraph have been applied with unusual success, resulting in remarkably low costs per ton of finished product.

The foundry of the General Fire Extinguisher Co. at Providence, is operated in connection with the Auburn works of the company, located in the southern part of the city This plant has been built for about four years and sufficient time, therefore, has elapsed to thoroughly demonstrate the correctness of the principles on which the shop is managed. The results achieved have been so satisfactory that practically no changes have been made in the method of operation since the plant was started, although within the past year extensive additions were made to the foundry materially increasing its capacity for handling both light and heavy work.

The product of the foundry includes the ells, tees, crosses, reducers, etc., that are used in the installation the company's automatic sprinkler systems. They are made of cast iron and the molds are put up and shaken out in such a systematic way and in such a continuous stream, that one familiar with the older foundry methods thinks he is in a magician's house. At present the foundry has a capacity of from 80 to 100 tons per day including pipe fittings of all sizes ranging from ⅛-inch to 24 inches in diameter. The foundry proper is 340 feet in length and 100 feet wide, two stories high, with a basement under one end of the ground floor. The first floor is used entirely for handling sand and castings, the molding and core making operations being confined to the second floor. The core room is approximately 160 feet long and 50 feet wide and is separated from the molding room by a partition about seven feet high. Originally the shop was only 240 feet in length, an extension 100 x 100 feet having been added a little more than a year ago. The extension is used principally for jarring machine work, although a number of stations for molding small pipe fittings on split pattern, vibrator molding machines are included in it. The cleaning department occupies a separate building and the cupolas are housed in a four story structure which joins one side of the main building near the middle.

The general plan of operation is shown clearly in Figs. 1 and 2, and a detail of one of the molding machine

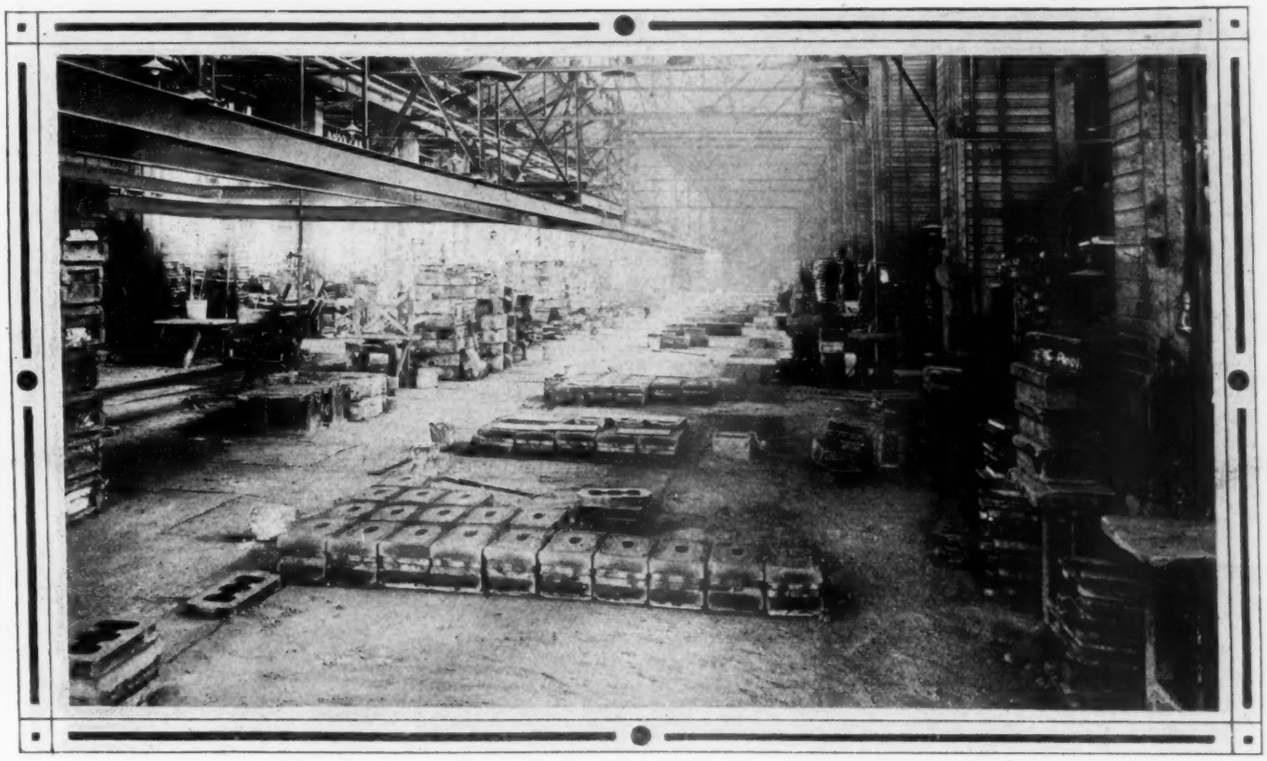


FIG. 1—MAIN MOLDING FLOOR IN FOUNDRY OF GENERAL FIRE EXTINGUISHER CO., SHOWING MONO-RAIL FOR HOT METAL AND GRATINGS AND CHUTES FOR SAND AND CASTINGS

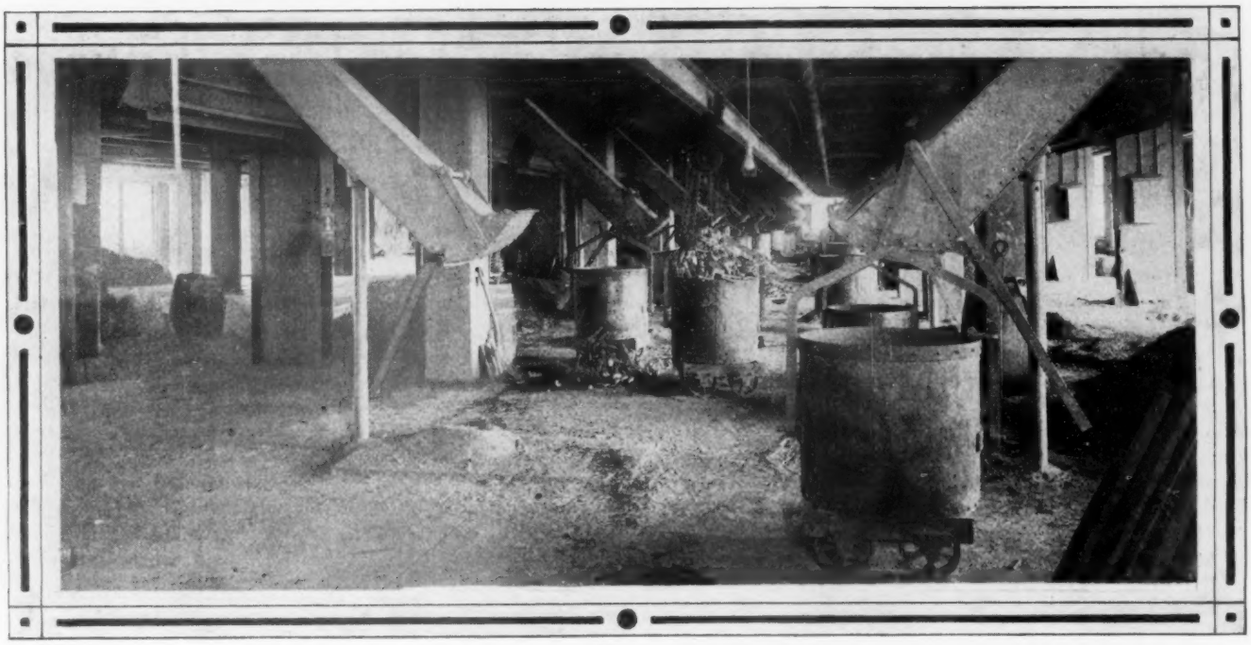


FIG. 2—UNDER THE MOLDING FLOOR, SHOWING LOWER ENDS OF CASTING CHUTES AND SAND BINS

stations is illustrated in Fig. 4. Pipe fittings up to 12 inches in diameter are molded on split pattern machines at stations similar to that shown in the latter illustration. The method of handling the work is simple and effective and no time is wasted in unnecessary operations. The molding machines are arranged along the wall under chutes which connect with sand elevators that bring the prepared sand up from the floor below. Between each pair of machines and the central gangway is a space about 20 feet long and 12 feet deep for receiving the molds which are waiting to be poured. At the rear of this space is a pair of gratings each about four feet wide and eight feet long on which the molds are shaken out and nearby is a chute for conveying the castings to the floor below. As fast as the molds are shaken out the sand falls through the gratings into bins, and from thence to the first floor where it is cut over and tempered before being returned to the molders. The castings with their gates and sprues attached are picked off the grate with an iron hook and dropped into the chute mentioned above, which discharges them on the first floor between the sand heaps as indicated in Fig. 2. The castings are loaded from the floor into buckets in which they are transferred to the cleaning room by an overhead mono-rail and the gates and sprues, which have been knocked off in coming down the chute, are loaded into similar buckets for transportation to the cupola charging floor.

The sand is discharged from the bins under the gratings onto the first floor in long windrows as shown in Fig. 6. The proper amounts of new sand and water are added and the windrow is cut over and tempered as it lies on the floor by an auto sand mixer, after which it is shoveled into the boots of

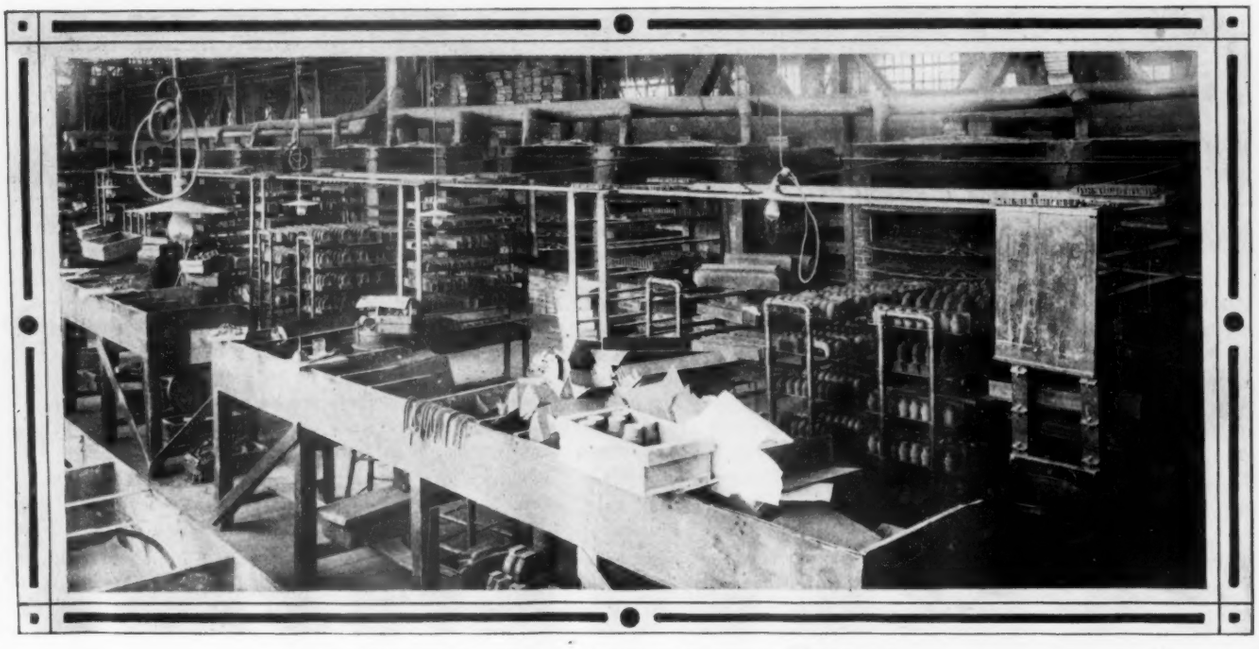


FIG. 3—THE CORE ROOM IS COMPACTLY ARRANGED

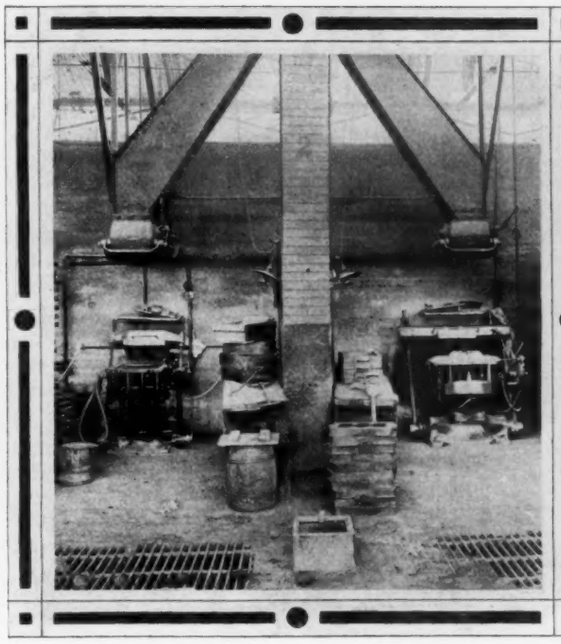


FIG. 4—ONE OF THE MOLDING STATIONS SHOWING MACHINES UNDER THE SAND CHUTES

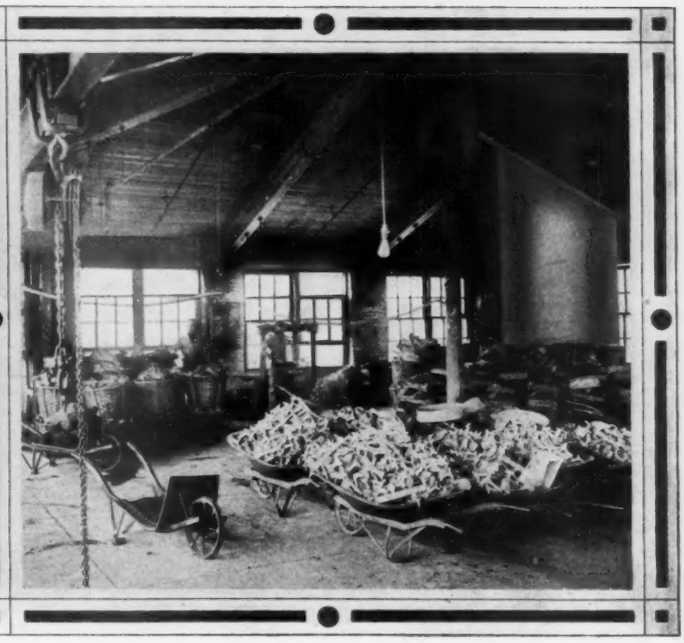


FIG. 5—THE COKE IS HANDLED IN BASKETS AND THE THE IRON AND SPRUES IN WHEELBARROWS

the elevators which convey it to the chutes over the molding machines on the second floor.

The iron is brought to the molder in bull ladles by the overhead mono-rail system shown in Fig. 1. The molders, however, pour their own floors with small hand ladles of the usual type.

In order to concentrate the responsibility for spoiled work each molder and helper are required to do all of their own work including making the molds, transferring them from the machines to the floor, jacketing, shifting weights, pouring and shaking out. In addition each man handles his own flasks. The work is paid for on a straight, piece-rate basis and the spoiled castings due to faulty molding are charged against the molder at full price. In some cases, where the men work in pairs, the responsibility and the pay are divided evenly. Helpers in the ordinary sense of the word, are unknown in this foundry. Although this plan may seem to have some objectionable features, it has been found to be very satisfactory in operation and certainly has been of considerable assistance in maintaining the high standard of quality which is absolutely required in the sprinkler business. When work does not turn out right, the molder has no alternative except to shoulder the responsibility himself.

The question naturally may be asked, "Who is responsible in case the iron is bad?" The answer is that this shop does not have any bad iron. While this may not be literally true, nevertheless bad heats are extremely rare occurrences and months frequently pass with-

FIG. 6—THE USED SAND IS DROPPED FROM BINS ONTO THE FIRST FLOOR FOR RENOVATING

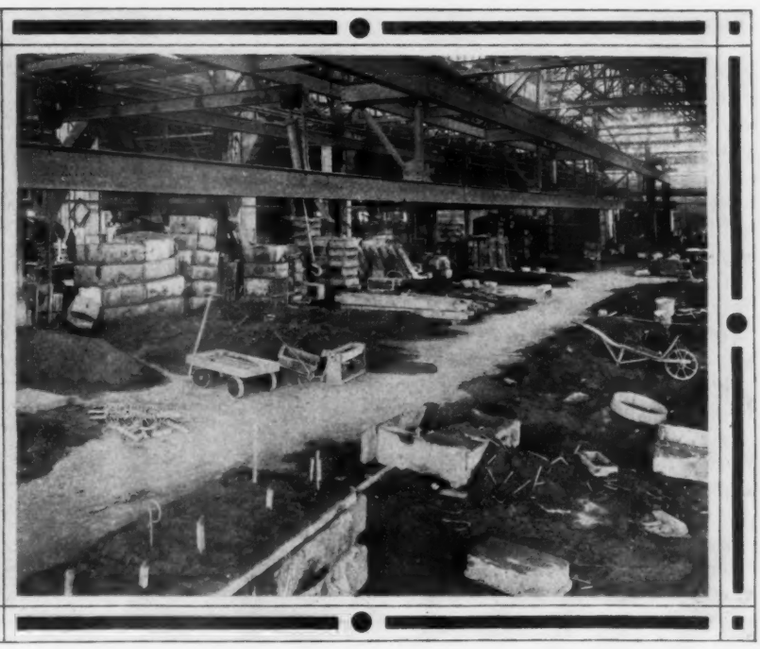


FIG. 7—JARRING MACHINE FLOOR AT END OF THE DAY'S WORK

FIG. 8—TRANSFERRING HOT IRON FROM RECEIVING LADLES TO TROLLEY LADLES

out the slightest complaint from the molders in regard to the character of the iron. The melting operations are given special attention and unusual precautions are taken to insure a uniformly satisfactory grade of iron in the ladles. Furthermore, if the molder thinks that the iron is unsatisfactory he does not have to accept it. In such a case his complaint is immediately investigated, and if justified, remedial measures are taken at once.

There are 26 sand elevators, spaced at equal distances of 20 feet along each side of the molding room. Each elevator discharges into two chutes as shown in Fig. 4, thus providing for the operation of 52 squeezer machines. As mentioned above, pipe fittings up to 12 inches in diameter are molded on split pattern vibrator molding machines and the larger sizes are handled on the jarring machines.

Fig. 4 shows a pair of machines fitted up to mold small elbows. The patterns are mounted on plates and two castings are made in each mold. Both the cope and the drag are made on the machines, which are supplied with air at 80 pounds per square inch pressure. Except for a thin layer next to the pattern, the sand is not riddled and the concrete floor and the iron gangway are kept clean and free from sand. The molds are made in wooden snap flasks and are provided with band steel jackets.

Fig. 9 shows how 6-inch flanged elbows are made using green sand cores. The molders work in pairs and two men put about 50 molds per day, there being two elbows in a flask. Wood flasks are used for this job and also for practically all of the work in the shop requiring other than snap flasks. A completely equipped flask shop is located in the basement of the building and all of the flasks are kept in first class condition. The flask shop is provided with electrically driven saws, planers and other woodworking tools. Alongside the flask shop in the basement is a large room utilized for the storage of flasks which are not in use. These flasks are protected from the wind and weather and, therefore, are in good condition when they are wanted.

The heavy fittings and special work are molded on the floor using jolt ramming machines as indicated in Fig. 7. This department occupies a portion of the molding floor next to the core room and is about 50 feet wide and 100 feet long. The equipment includes various sizes of Mumford pneumatic jolt ramming machines. For handling the heavy molds, air hoists have been installed over the jarring machine tables as indicated in Fig. 7 and in addition, the entire floor is served by a traveling crane. Pipe fittings are made in this department with green sand cores up to 16 inches in diameter. On many of the patterns for the larger fittings different kinds of flanges are required. When it is desired to change a flange all that it is necessary to do is to remove three screws, take the old flange off and put the new one in its place and insert the screws.

As suggested above, green sand cores are used wherever the nature of the work permits. They have several advantages. In the first place the expense of handling and making dry sand cores is eliminated and the aggregate amount of core room labor is kept at a minimum. In addition, the green sand cores are made on the floor where they are used and are always ready for the molds.

FIG. 9—MOLDING 6-INCH FLANGED FITTINGS WITH GREEN SAND CORES

Also they shake out easier than dry sand cores and are not so liable to cause fins in the castings.

Most of the green sand cores are made in hinged cast iron boxes as shown in Fig. 9. They are rammed by hand and are supported by heavy cast iron arbors. In some cases a plate with a tapped hole is located in the center of the core so that it can be easily handled without breaking. A rod with a handle is screwed into this plate in order to lift the core and set it into the mold. In other cases the core can more conveniently be handled by the projecting ends of arbor. The core rests in prints which together with the arbor prevent it from shifting.

The room in which the dry sand cores are made is about 50 feet wide and 160 feet long. It is arranged as indicated in Fig. 3, the benches being near the windows while the ovens are placed at the rear alongside the partition which separates the core room from the molding room. Girls are employed for making the smaller dry sand cores and special wash and rest rooms have been fitted up for their convenience. Car ovens, ordinary shelf ovens, and special turnstile ovens are used for drying the cores. There are two double-end car ovens which are fired by coal and are used for baking the larger cores at night. The turnstile ovens are arranged in pairs as indicated in Fig. 3. Each oven has five shelves or circles. They are fired by oil and the gases pass out through a common stack. The smaller cores are baked at a temperature of about 400 degrees Fahr. and approximately 20 minutes are required for baking one-inch elbow cores and 40 minutes for baking two-inch cores. For some of the cores a pure oil sand mixture is used but for most of the work a glucose mixture is employed.

The foundry is provided with two Whiting cupolas with a diameter of 54 inches inside of lining. They are used alternately and a single, Roots positive pressure blower furnishes the blast. Although there is no spare blower, no delays have been experienced owing to the failure of the blowing equipment. The melting is semi-continuous, that is two heats are taken off per day, one from each cupola, in the forenoon and the afternoon respectively. There is no chance, therefore, for the molders' floors to become congested and the work of the cleaning and sand handling departments is uniform.

When the heat is over, the bottom of the cupola is dropped onto an iron grid which is hauled out to the cinder mill with a chain tackle and winch. The cinder is broken up and put through a Sly water mill which separates and reclaims the iron.

The charging floor, which is about 50 feet square, occupies the uppermost story of the four-story cupola house. The latter is of sufficient size so that a third cupola may be added if necessary. The charging floor is served by an elevator which communicates directly with the iron yard outside the foundry. The coke charges are handled in wicker baskets which hold about 100 pounds each; the pig iron is handled on wheelbarrows and the sprues come to the charging floor in steel buckets about 3 feet in diameter and 4 feet deep, or in barrows.

A practically uniform mixture consisting of northern and southern pig iron, machinery scrap and returned gates and sprues is used. The proportions are controlled by chemical analysis and a first class grade of iron is required inasmuch as the castings must be soft enough to be easily machined, tough enough to withstand hard usage and high water pressures and must also be fine grained with no blow holes or porous spots that might cause leakage.

The metal is tapped from the cupola into large, gear-tilted, bottom-pour receiving ladles from which it is transferred to the trolley ladles as indicated in Fig. 8. The latter are used for distributing the iron to the various floors by means of the overhead mono-rail system. Usually four trolley ladles are employed. Safety switches are installed in the mono-rail so that it is impossible to run a ladle of hot iron off the track and thus cause bad burns or a more serious accident. The mono-rail is laid out in the form of two loops which extend in both directions from the cupolas and each loop is provided with several cross-overs so that the

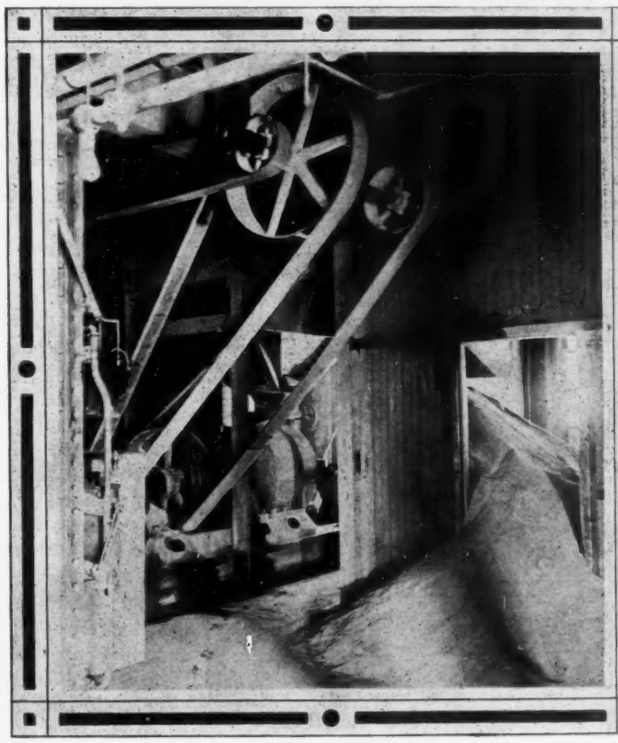


FIG. 10—RECLAIMING BURNED SAND BY GRINDING IT WITH CLAY

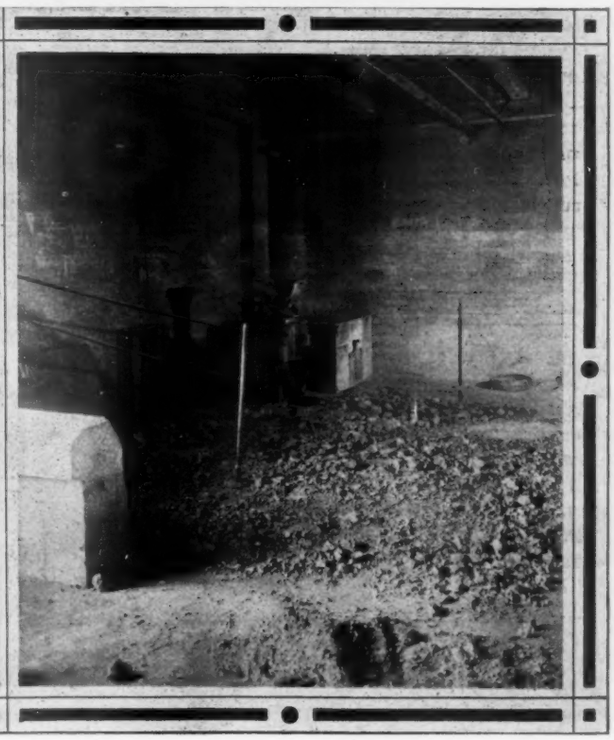


FIG. 11—BREAKING AND GRINDING BURNED CORE AND MOLDING SAND PREVIOUS TO MIXING WITH CLAY

empty ladles may be brought back without going to the extreme end of the foundry. This also enables one ladle to be switched past another. The trolleys run very easily and one man has no difficulty in handling a full ladle. The ladles are dried in a three deck, car type oven, which is used for drying both the hand and trolley ladles. The ladles are under the care of a special department and the hand ladles are delivered to the molders in good condition at the beginning of each heat.

The general features of the sand handling system have been outlined above. The bars in the gratings through which the sand is dumped from the molding floor are spaced about one inch apart. The bins under the gratings are made of heavy steel plate and are provided with gates so that they can be opened and their contents dumped at the pleasure of the men working on the floor below. The sand is cut by an auto sand mixer furnished by the Sand Mixing Machine Co., 220 Broadway, New York. The general features of this machine are well known to foundrymen. The machine is operated by electricity which is conveyed through a cable that automatically winds and unwinds as the mixer moves up and down the floor. The machine is sent twice through each windrow of sand and this double cutting puts it in good condition for the molders. The machine cuts over both rows of sand in about an hour, and to do this work by hand a large gang of men would be required all day. The prepared sand is shoveled directly from the floor back into the boots of the elevators which return it to the molders' stations.

The burned sand which comes down the chute with the castings together with the gangway sand, burned core sand, sweepings, etc., is collected and ground up in the mill shown in Fig. 11. The ground sand is then mixed with a proper proportion of clay and put through another mill, the resulting mixture being suitable for use again in the molding room. It supplements the new sand and is incorporated with the molding sand when the latter is cut over by the auto mixer. This process has considerably reduced the total quantity of waste sand and the little that remains is used for filling the foundry yard.

Core Sand Mixer

The core sand mixer was furnished by the Standard Sand & Machine Co., Cleveland. It has a maximum capacity of about ten tons per hour and the compound is heated by steam. The prepared sand is transferred from the discharge end of the mixing machine into the boot of a bucket elevator which carries it up to the core room above. The core sand is obtained from a pit located on the company's property less than 50 feet from the foundry building. There is sufficient sand in this deposit to provide for the needs of the shop for a great many years to come.

FIG. 12—CLEANING ROOM SHOWING CONTINUOUS TUMBLING MILL AND STEEL BARRELS USED FOR HANDLING CASTINGS

Practically all of the sprues and gates break off of the castings as they rattle down the chutes from the molding room to the ground floor. It is an easy matter, therefore, to separate the sprues from the castings. A mono-rail which extends the whole length of the first floor between the casting chutes and also into the cleaning room and cupola house is used for transferring the castings and sprues which are handled in buckets as indicated in Fig. 2. The trolleys which are operated on the monotrucks also are used to handle the rail are provided with Yale & Towne triplex hoists for lifting the heavy buckets of castings or sprues and small bucket around the chutes as shown in the illustration. On the way to the cleaning room the monorail passes through the pickling department and such castings as require treatment of this nature are deposited at this point. The cleaning room itself is equipped with seven Sly tumbling mills of the usual type and also with a large continuous mill furnished by the W. W. Sly Mfg. Co., Cleveland.

The latter is shown clearly in Fig. 12. In addition to the tumbling mills the cleaning room includes a large number of grinding wheels of the usual type. These are all equipped with safety hoods connected to a dust exhaust system. The finished castings are dumped into steel barrels similar to those shown in Fig. 12 in which they are transferred to the store room or to the machine shop. The barrels, as will be noted, are provided with trunnions by which they are handled on special trucks designed for the purpose. These buckets or barrels are used freely in the store room for holding castings in place of bins. They are economical and have the advantage of being portable. Before leaving the foundry the castings are weighed and counted. The latter operation is performed automatically by means of a scale. A barrel of castings is placed on the platform of the scale and from two to ten castings, according to their size, are placed in the scoop. The scale then automatically gives the count or number of castings in the barrel, deducting the weight of the empty container.

At the Providence plant the company does all of its brass, bronze and aluminum work and the same modern methods are in vogue as at the Auburn works. The large output in both Auburn and Providence is all the more remarkable when the quality of the work is considered. By far the greater part of the product of both plants is used in the construction of automatic sprinkler systems and the company maintains a large industrial laboratory to make certain that all materials are of a uniformly high quality.

Operating a Brass Foundry Under Difficulties

In Mexico old rifle and cannon cartridge shells are used as raw material and explosions sometimes occur in melting

By H H Miller

THE accompanying illustration shows a pile of scrap brass consisting of empty rifle and cannon cartridge shells picked up on the battlefields after the fights at Torreon, Mex., and vicinity. Thus far I have melted about two tons of these shells and a dealer in scrap metal in Torreon has just shipped eight tons of shells to the United States. Another dealer at San Pedro, Mex., where a big battle was waged is now offering for sale five tons of this scrap. During the occupation of Torreon by the Constitutionalists they melted several tons of these shells while in possession of the foundries in that city. Naturally, thousands of these shells never will be recovered, but the accompanying illustration graphically indicates that there has been some shooting in this vicinity during the past two years. A large number of these empty shells will be shipped to the United States in the near future, owing to the fact that many American junk dealers now are in Mexico, buying scrap metals of all kinds. However, any foundryman handling these shells should observe every possible precaution. I have just returned from El Paso, Tex., where I have been treated by an eye specialist and he informs me that the sight of one of my eyes always will be impaired as a result of my experience in melting these shells.

SCRAP BRASS NOW USED IN MEXICO

A large number of the rifle shells still have the primers intact and many still contain powder. These undoubtedly are the shells reloaded by the rebels and evidently the bullets were not pressed in firmly, and as a result, dropped out. In melting these shells they usually are charged into the crucible with a small scoop and the face of the melter should be turned away from the crucible while charging, and the furnace also should be quickly closed. The furnace is left closed and no attempt is made to poke down the shells until they have had time to get hot and explode all the caps and powder. As a rule, these explosions are not of sufficient force to injure the crucibles.

The accident in my foundry was causd by a large cannon shell. I threw it into the crucible which was almost filled with molten brass, and as I did not anticipate any trouble I did not get away as promptly as necessary under the circumstances. The primer was still in the shell and the explosion burst the crucible, and as a result the air for a time was filled with fire, molten brass and powder. My face was badly burned and as a result the sight of one of my eyes will be impaired. Since that time we are observing every possible precaution to remove the primers from all of the shells. If any of this scrap is sent to the United States I suggest that all foundrymen examine the shells carefully before charging them into the crucibles. The primers are screwed into the shells and can be removed easily.

Non-Ferrous Mixtures

An improvement in the manufacture of aluminum bronze is suggested in the patent granted to Edward D. Gleason, of New York City. Into a fused bath of three parts of calcium fluoride and one part of fused boracic acid, aluminum ingots are introduced and the mass when molten is stirred and cast into ingots.

This mixture then is added in an amount slightly in excess of 10 parts to 90 parts of pure copper melted under a cover of charcoal and black oxide of manganese. It is claimed that the resulting alloy is free from oxide of aluminum.

Mr. Gleason also has patented a method of making plastic compositions of lead-copper and lead-copper-tin, such as are used for bearing metals and which sometimes develop defects due to the lack of affinity of the lead for the copper or copper and tin. It is claimed that such alloys can be made homogeneous by incorporating a non-metallic derivative of lead, such as the sulphide mineral, galena. For example, 60 pounds of copper may be melted and to this is added 5 pounds of galena and then gradually 30 pounds of lead and 5 pounds of tin are added to this mixture.

Coloring Aluminum

A new method of coloring aluminum has been patented by Albert Lang, Karlsruhe, Germany The aluminum is treated with hydrochloric acid chloride of copper or chloride of iron and then without rinsing, is heated. A film is left on the surface, which may be lacquered if desired. Hydrochloric acid imparts a white coating, chloride of copper a black coating and that obtained by chloride of iron is gray. It is claimed that the best results are obtained when enamel is applied over a coating of this kind.

Melting and Casting Non-Ferrous Metals

A resume of a year's advances in brass and aluminum foundry practice with special reference to furnace construction and operation

By C Vickers

THE most practical and convenient method of shaping metals is to convert them to a liquid state and to cast the molten mass into receptacles of the form it is desired the metals shall assume when they again revert to the solid condition. This method of creating objects is known as founding, an art naturally divided into two important operations; namely the liquefaction of the metals and the construction of the temporary receptacles or molds. While substances other than metals may be cast, notably plaster of Paris and cement, such operations are not included under the general term *founding* which is applied only to the forming of metallic shapes by the operations of melting and casting.

The two operations of molding and melting generally proceed simultaneously; while the metal is melting, the molds are being constructed, although there are exceptions to this rule, as in the case of castings which it is necessary to make in thoroughly dried molds, when the molds are constructed and dried before the metal is melted, a method largely followed in steel foundry practice. In both of these operations, difficulties are encountered which operate to bring about monetary losses through defective castings, the waste of metals by oxidation during the melting and by spilling during the casting process. To control these losses by improved methods of melting and molding, to increase the production of castings and to reduce to a minimum the necessity for highly developed individual skill, is the aim of modern research and invention in the foundry industry. Modern progress in melting metals, other than iron and steel, has been far from revolutionary, as the older methods are still extensively used and frequently are given the preference when melting equipment is being installed in new casting plants. It is largely a matter of opinion and of local conditions as to what type of furnace shall be selected, and whether solid, liquid or gaseous fuel shall be used for the melting medium. Solid fuel furnaces are the oldest of the existing types, and in the case of copper and its alloys have been improved very little in recent years, in fact little improvement is possible beyond what has been accomplished in converting such furnaces from fixed to portable units.

Solid fuel furnaces consume either coke or anthracite coal, and combustion is promoted either by a chimney of requisite height, by forcing air into the furnace, or by driving out the products of combustion from a short stack by means of a jet of steam or compressed air. Of these various types the blast-driven furnaces are the most dependable for solid fuel, as they are not affected by weather conditions and melt more rapidly than natural draft furnaces. The latter, however, possess many good features, chief among which is the absence of gas leakage, as the products of combustion are drawn away to the outer air leaving no possibilily of the shop atmosphere being contaminated, which frequently is the case when the air is driven into the furnaces. Jet-driven furnaces operate the same as those of the natural draft type. They

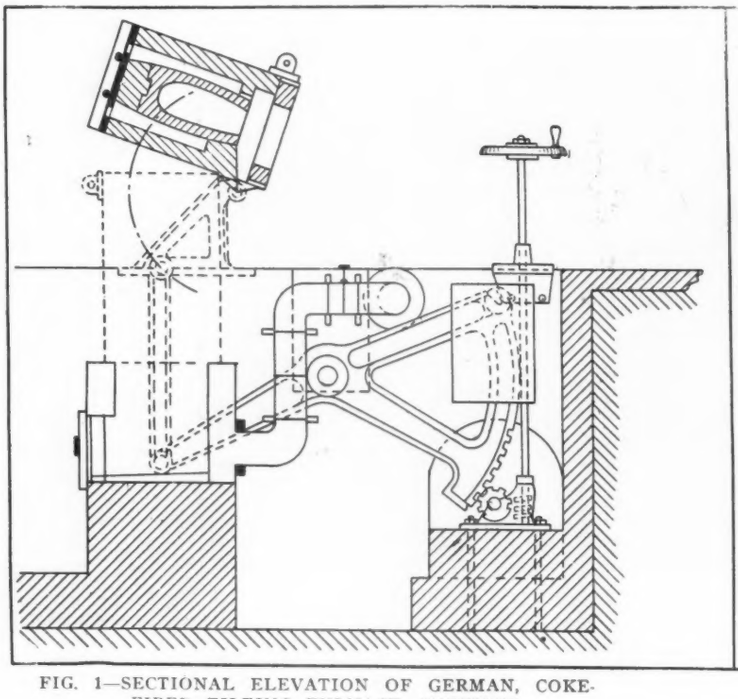


FIG. 1—SECTIONAL ELEVATION OF GERMAN, COKE-FIRED TILTING FURNACE, SHOWING TILTING MECHANISM

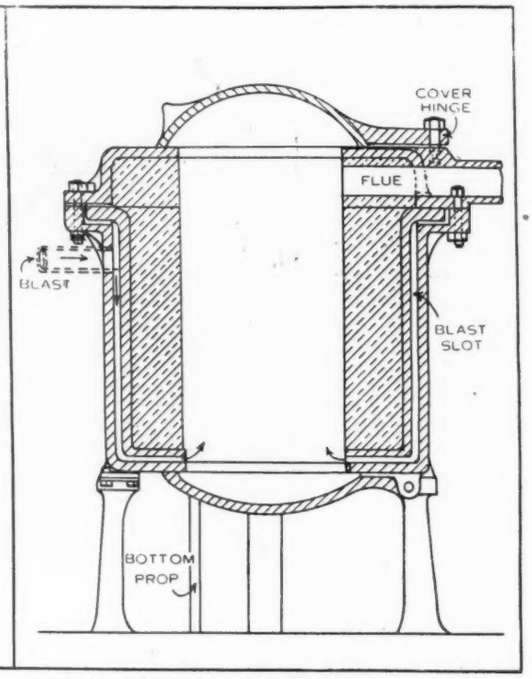


FIG. 2—SECTIONAL ELEVATION OF A BLAST-DRIVEN CRUCIBLE FURNACE WITH SUSPENDED LINING

are seldom used, however, but are entitled to serious consideration to meet certain requirements. A jet drive is economical where it is impracticable to erect a sufficiently high stack to insure the requisite draft, and where steam or high pressure air is conveniently at hand. Such conditions often are found in foundries located on the upper floors of power buildings in large cities, where low ceilings are the rule and stacks cannot be erected to a sufficient height to provide satisfactory natural draft. Such conditions make blast-driven furnaces undesirable as the products of combustion, under such circumstances, would be driven into the shop to the detriment of the workers. In such cases the application of the jet is distinctly advantageous; it should enter the stack not more than four feet from the top, otherwise the power of the jet might not be sufficient to lift the column of air above it and create a draft.

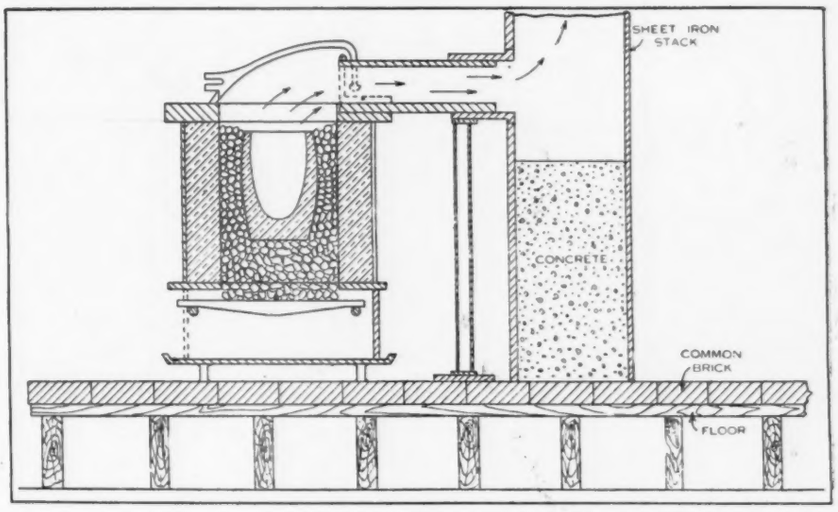


FIG. 4—SECTIONAL ELEVATION OF NATURAL DRAFT BRASS MELTING FURNACE

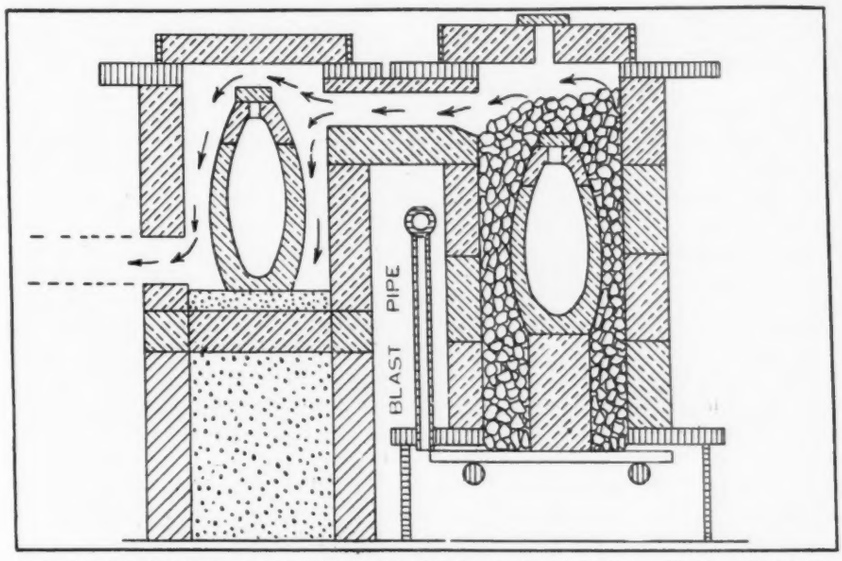


FIG. 3—ANTHRACITE COAL-FIRED FURNACE FOR MELTING WROUGHT IRON, PROVIDED WITH A PREHEATING CHAMBER SUPPLIED WITH HIGH PRESSURE BLAST

When compressed air only is available, it is more economical to use it to create a draft in the form of a jet, than to employ it under the grates of the furnace. In one instance in the writer's experience a coke furnace was successfully operated with a stack less than six feet high, in which the draft was produced by a jet of compressed air at a pressure of 40 pounds. The furnace melted rapidly and attained a high temperature after the introduction of the jet. When introduced under the grate bars into a sealed furnace pit, the jet of compressed air failed to melt copper, although the latter was kept in the furnace for seven hours on one occasion, but when the ash pit was opened and the jet turned into the stack, the furnace melted normally and was capable of melting three heats of copper per day.

Solid fuel tilting furnaces first were introduced in Europe, the Pyott being one of the earliest types. This furnace was fully described in an early issue of THE FOUNDRY and prior to that time such furnaces were unknown in this country. The Baumann tilting crucible furnace, an improvement on the Pyott, is shown in Fig. 1. It will be noted that this furnace was installed in a pit from which it was elevated and tilted for pouring out the metal by a rather complicated collection of levers, acting through the medium of a toothed segment, a gear and a worm operated by a hand wheel. The melting capacity of this furnace was claimed to be 224 pounds of copper, brass or bronze in 20 minutes with a fuel consumption of from 15 to 20 per cent of the weight of the metal melted.

A recent addition to the list of solid fuel tilting furnaces is the Monarch

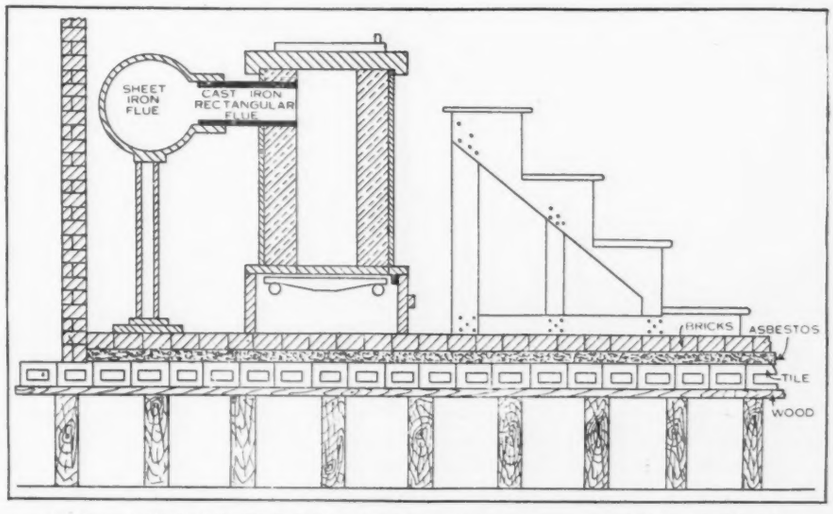


FIG. 5—FURNACE OF REGULATION HEIGHT WITH WOODEN STEPS TO FACILITATE CHARGING AND PULLING POTS

FIG. 6—A BATTERY OF COKE-FIRED NATURAL DRAFT FURNACES

tilting crucible type, built by the Monarch Engineering & Mfg. Co., Baltimore. Similar to most of the later types of solid fuel tilting furnaces, the Monarch revolves on the regulation coke hole, with the height of the furnace, the mouth thus describing an arc when tilted. Some remarkable records are claimed for this furnace, which possesses a number of novel features, such as shaker grates and a bottom that can be dropped for natural draft. Other well known furnaces of this type are the Ideal, the M. R. V., etc. Solid fuel tilting furnaces are efficient as regards fuel consumption and melting capacity.

The tilting type of solid fuel furnaces were designed as an improvement on the regulation cokehole, with the idea of abolishing the laborious task of pulling pots. Considerable attention also has been directed to improving the pit furnace to effect further fuel economies and increased speed of melting, without changing its general design. In Fig. 2 is shown a furnace embodying a number of improved features such as hot blast and drop bottom. The body of this furnace is cast iron, the lining being suspended in an inner cast iron shell in such a manner as to form an annular space between the inner and outer shells. The blast enters the top of this annular space and issues from a circular opening at the bottom of the furnace.

The advantages claimed for this furnace are rapidity of melting, low fuel consumption and ease of operation, the latter being due to their shallowness and to the fact that they are set in a pit, one coaling only being necessary for a No. 100 pot. The disadvantages are the pollution of the shop atmosphere by gases which are driven in immense volumes from underneath the cover. When the furnace is started cold on a fresh charge, the gases consist largely of carbon monoxide (CO), but after the fuel has burnt through, sheets of flame issue horizontally from underneath the cover, the CO, to a large extent, being burned to carbon dioxide (CO_2), but mixed with a considerable proportion of sulphur dioxide (SO_2). As a result, the atmosphere of the entire shop, at times was blue, and the men suffered severely, although the entire roof of the room in which the furnaces were installed was cut away. This evil could have been corrected by a proper arrangement of hoods and the adoption of larger furnace flues, but 25 years ago such refinements in brass foundry practice were little thought of. Another difficulty occurred from metal getting into the annular blast opening at the bottom of the furnace when the crucible broke. This was a difficulty overlooked by the originator of the furnace, who believed that the furnace bottom would be dropped allowing the metal to fall into the ash pit. A considerable time often elapsed, however, before a leaky crucible was discovered, and the metal in the meantime collected in the concave bottom and overflowed into the blast slot.

Then, although the blast was heated to some extent, it was cold compared to the molten metal, and when a pot suddenly collapsed, the entire furnace bottom was flooded, the metal in the blast slot being immediately chilled, solidified and remained after the bottom was dropped; the furnace was put out of commission and before it could be used again, the lining had to be torn out, and the inner shell removed. This operation often resulted in the breakage of the inside shell, which was riveted to the outer shell by the metal covering both flanges. The result was that pieces of the flange of the inner shell generally were broken away, making pot breakage exceedingly expensive.

A novel type of the solid fuel pit furnace, shown in Fig. 3, was designed and built by the writer in 1895. It

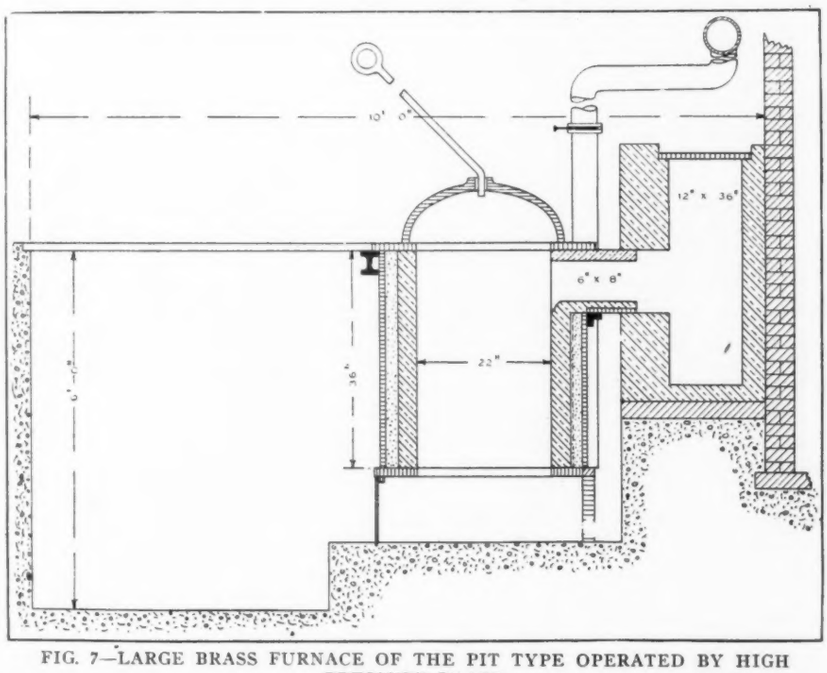


FIG. 7—LARGE BRASS FURNACE OF THE PIT TYPE OPERATED BY HIGH PRESSURE BLAST

was driven by blast supplied at a pressure of 16 ounces. It will be noted that the flue is enlarged to form a preheating chamber, one pot having been placed in the melting hole and the other in the flue. The furnace was fired with anthracite coal and primarily was intended for melting wrought iron. Starting up cold, 100 pounds of wrought iron (Swedish iron from horse nail scrap) were melted in 3½ hours. After the pot of molten metal was drawn, it was replaced by the hot crucible from the flue and in the latter a cold pot was set. The second pot usually was ready for pouring in 1¾ hours. It will be noted that the fuel was piled high above the crucible, a practice unnecessary in the case of copper alloys, but essential with wrought iron, the idea being that the coke above the crucible forms a reserve to push down the sides as the lower layers of fuel were burned. The fuel always was charged on top of the pot and when it commenced to burn, carbon monoxide (CO) passed over into the chamber in the flue, where it was met by a small blast of air, not shown in the illustration, with the result that the chamber was filled with flame which heated to a bright red, the second crucible and its contents.

Another novel type of furnace, shown in Fig. 4, is compact in design, an efficient melter and was designed to meet special conditions, such as low head room and the elimination of furnace pit or tank and high stack. The sheet steel stack was 18 inches in diameter and 20 feet high and served two furnaces. The furnace was cut off below the cast iron flue, which was laid into a recess cast in the top ring of furnace, and the other end was fitted into a square opening in the stack. The stack rested on the floor behind the furnace and was filled with cement to a point slightly below the level of the flue connection. The cement anchored the stack and the section extending above the roof was suitably guyed. The cover formed the connection between the furnace and the flue and was designed to slide back on the flue, in which position the draft was cut off and a pot could be held as long as was desirable without any great risk of overheating. The furnace was very shallow and was set on the floor like a stove, thereby eliminating the necessity for steps which would have been required if the furnace had been built full height as shown in Fig. 5.

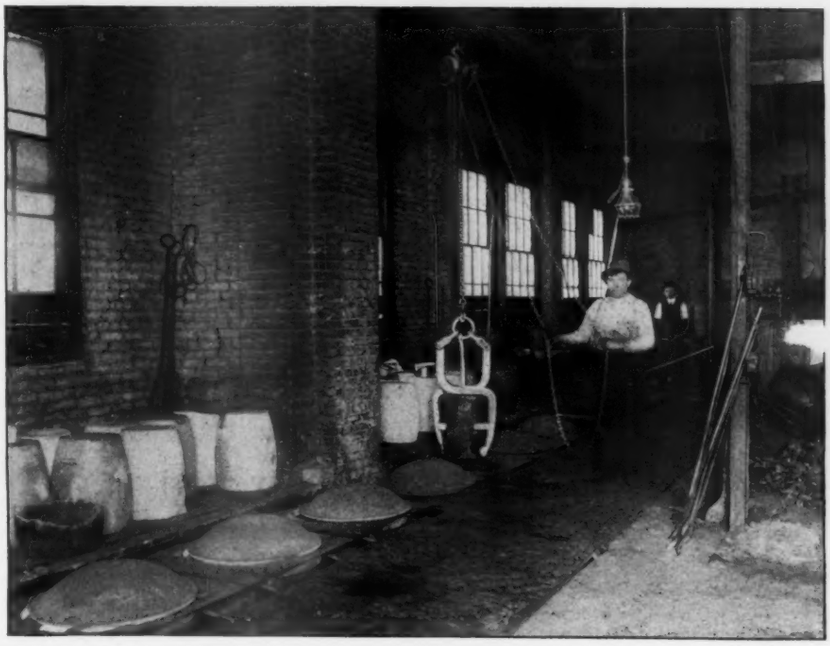


FIG. 9—A BATTERY OF COKE-FIRED BRASS FURNACES SHOWING THE POT BEING PULLED BY A PAIR OF GRAB TONGS

Drawing the Pots

This furnace was installed in a foundry located on the top floor of a building. This furnace is the regulation height, and either from motives of economy or because of necessity, was not suspended in a tank, but was set on the foundry floor like a stove and consequently it was necessary to provide steps to enable the fires to be reached and the pots to be withdrawn. Furnaces installed in this manner usually are small, taking a No. 35 or 40 pot, but occasionally they are of sufficient size to operate with a No. 70 crucible. The manner in which the pots customarily are pulled requires skillful manipulation on the part of the furnace tender and his helper. The furnace tender raises the pot and adjusts the tongs and then both the molder and the furnace tender assume positions on either side of the furnace, with one foot resting on the top step, and the other on top of the furnace. Both men then grab the tongs, one taking the underhold and by a sudden lift raise the pot clear of the furnace and swing it between them to the bottom step, resting it momentarily on a piece or iron or the botton of an old crucible, to prevent burning the steps which generally are wood. The men then make a quick descent and swing the pot to the skimming hearth. It is unnecessary to point out that this is a somewhat dangerous practice and should be improved upon, although it is accomplished every day with very few accidents. By the use of a bar, three men pull the pots from the furnace, Fig. 4, and the same method is pursued when pulling a large pot from the furnace, Fig. 5.

In Fig. 6 is illustrated an improved method of installing a battery of coke-fired, natural draft furnaces above the ground floor. This practice, however, is not always feasible as it entails occupancy of the floor underneath, or at least that portion of it below the

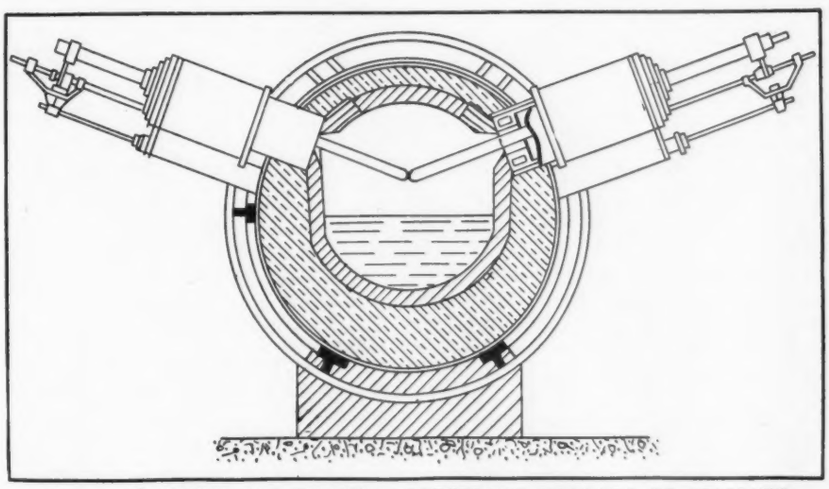


FIG. 8—CROSS-SECTION THROUGH ELECTRODE HOLDERS OF STASSANO-PETINOT ELECTRIIC FURNACE

furnaces which is enclosed and is practically a large ash pit. The furnaces are set on girders of the requisite height to bring the tops of the furnaces level with the foundry floor. There is a growing tendency to place furnaces, located on upper floors, in tanks suspended from the walls and floors, and generally they are set about 12 inches above the floor level.

Fig. 7 shows a conventional installation of large, blast-driven coal-fired pit furnaces set level with the floor and equipped with a narrow flue to economize floor space. The closed ash pit is set on a concrete step facilitating the removal of the ashes, the adjustment of the grate bars, etc. This furnace is designed to accommodate a No. 150 crucible; the area of the main flue is sufficiently large to carry five furnaces with a considerable margin of safety, provided the furnaces are operated with natural draft instead of by forced blast. Forced draft furnaces require larger flues than those of the natural draft type, although the reverse condition frequently is found in actual practice. Unless the flues are large the products of combustion are driven into the shop, and it becomes necessary to equip the furnaces with hoods, and sometimes also with exhaust fans. Therefore, it is more economical to equip such furnaces with a flue sufficiently large to carry off the products of combustion.

Large Furnaces

In Fig. 8 is shown a battery of large, coke-fired, crucible furnaces and it will be noted that they are set level with the floor a feature more necessary in the case of large than small furnaces. An excellent system of pulling the pot is provided which includes an overhead track and a high speed hoist. Attention also is directed to the shape of the tongs which are both light and strong, the section on which falls the strain of lifting being heavy enough to prevent springing and the consequent dropping of the pot, while the handles, with which the melter merely guides the tongs into position, are as light as they can be made, consistent with the use to which they are applied.

While solid fuel furnaces are almost exclusively of the crucible type, there are some exceptions, aside from the use of cupolas to supply the metal for very large castings. One furnace designed recently to melt large masses of bronze for heavy gears, is of the tilting type, the blast passing through the trunnions into a wind belt from which it is delivered to the furnace through tuyeres, the arrangement being similar to that of a cupola. A certain type of French furnace, according to Brannt, was practically a natural draft cupola, the draft having been induced by an 80-foot stack, with which the top of the cupola was connected by a pipe. The air entered the furnace through a circular opening which extended around the cupola at about the same height as the tuyeres in an ordinary cupola. The part of the furnace below this air opening was entirely detached from the upper part, which was supported by suitable legs. The detached bottom formed the crucible or metal receiver and could be raised or lowered, thus permitting the width of the air slot to be varied at will and provided a means of regulating the combustion of the fuel. It is claimed that this furnace, owing to the regulation of temperature by the slot, produced an excellent, fine-grained bronze, superior to that obtained by melting in a crucible furnace.

The efficiency of solid fuel furnaces depends entirely upon the degree of skill with which they are operated and consequently results may differ within wide limits. For data on this subject the reader is referred to Bulletin 73, issued by the Bureau of Mines, Washington, D. C. Dr. H. W. Gillett is the author of this bulletin which bears the title, "Brass Furnace Practice in the United States." Data are contained in this bulletin covering the operation of the various types of oil-burning furnaces, therefore, it will be unnecessary in this article to enter into details regarding fuel efficiency, speed of melting, or metal losses, in the operation of the various types of furnaces described.

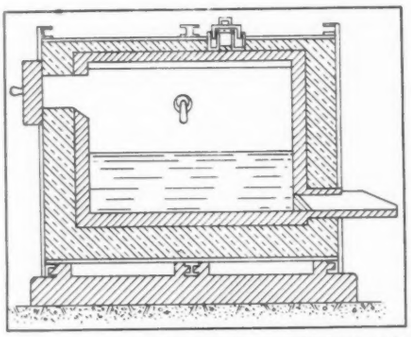


FIG. 10 — LONGITUDINAL ELEVATION OF STASSANO-PETINOT ELECTRIC FURNACE FOR MELTING COPPER ALLOYS

The oil-fired furnace is admirably adapted to melting metals in bulk as there are no solids to contaminate the metal. A well-known type of open-flame furnace possesses the advantage of allowing the metal to be easily *poled*, and those who have mastered the art of properly managing this furnace appear to be well satisfied with its operation. Other types of open-flame furnaces are the egg-shape, with either single or double chamber and the cylindrical furnaces which resemble a tumbling barrel. There are several different types of oil-fired crucible furnaces on the market, and individual preferences are largely the deciding factor in determining what particular type shall be selected when a new installation is contemplated.

Large jobbing foundries frequently operate several different types of oil-fired furnaces, and experience has shown that one furnace may be more suitable than another for some particular alloy.

Electric Furnaces

Electricity is another available agent for converting metals into liquid form. From the viewpoint of the brass founder, however, electricity as a melting medium is a possibility promising big development. One of the most recent electric furnaces for melting copper alloys is the Stassano-Petinot. Cross and longitudinal sections of this furnace are shown in Figs. 8 and 10. It is of the arc radiation type, that is, the melting is accomplished by an arc between two carbons suspended in the upper part of the furnace immediately above the bath. The heat from the arc is radiated upon the metal, which presumably should be covered with a slag of broken glass to protect its surface from oxidation for although the furnace is closed it is impossible to entirely exclude oxygen unless the furnace is filled with some inert gas such as nitrogen, hydrogen or carbon dioxide.

New England Foundrymen's Association

The New England Foundrymen's Association has issued its calendar of meetings for the fall and winter. A wide variety of subjects of interest to foundrymen will be discussed and many of the speakers who have been retained have a national reputation. The season's calendar is as follows:

Sept. 9 at Springfield, Mass., "Heating with Waste Gases," by P. M. Parks.

Oct. 14 at Boston, "Safety in Foundry Operations, or What Can the Employes Do to Avoid Accidents," by M. W. Alexander.

Nov. 11 at Boston, "Semi-Steel and Scientific Melting," by David McLain.

Dec. 9 at Boston, "Autogenous Welding and Cutting by Means of the Oxy-Acetylene Torch," by Henry Cave. Illustrations and demonstrations will be given.

Jan. 13 at Boston, annual meeting of association.

Feb. 10 at Boston, "Farm Efficiency," by L. C. Dodge of the United States Department of Agriculture.

March 10 at Boston, address by a representative of the National Red Cross Society.

April 14 at Boston, "Molding Automobile Cylinders," by J. J. Wilson.

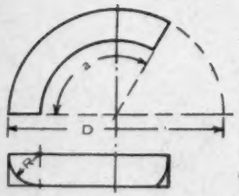
May 12 and June 9, subjects to be announced later.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

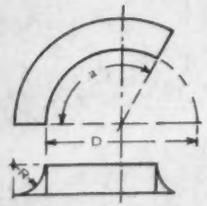
FORMULAE FOR FINDING THE WEIGHTS OF CASTINGS

By W. L. Tryon



To find the weight of a sector of an inside circular fillet, multiply the difference between the diameter of the cylinder made by the side of the fillet and the product of the radius and 0.446 by the radius squared by the number of degrees in the angle by the value of K corresponding to the weight per cubic inch of material used (see table below) or, from the diameter of the cylinder made by the side of the fillet multiplied by the radius squared by the number of degrees in the angle by K, subtract the radius cubed by the number of degrees by M.

$$W=(D-0.446R)R^2aK \text{ or } W=DR^2aK-R^3aM$$



To find the weight of a sector of an outside circular fillet, multiply the sum of the diameter made by the side of the fillet and the product of the radius and 0.446 by the radius squared by the number of degrees in the angle by K, or to the diameter of the cylinder made by the side of the fillet multiplied by the radius squared by the number of degrees by K, add the radius cubed multiplied by the number of degrees by M.

$$W=(D+0.446R)R^2aK \text{ or } W=DR^2aK+R^3aM$$

ALL DIMENSIONS IN INCHES AND WEIGHTS IN POUNDS

Wt. per cu. in.	K	M	C	Wt. per cu. in.	K	M	C	Wt. per cu. in.	K	M	C
.096	.000180	.000080	.000279	.250	.000468	.000209	.000727	.410	.000768	.000342	.001193
.100	.000187	.000084	.000291	.260	.000486	.000217	.000756	.420	.000787	.000351	.001222
.110	.000206	.000092	.000319	.270	.000505	.000226	.000785	.430	.000805	.000359	.001251
.120	.000224	.000101	.000349	.280	.000524	.000234	.000815	.440	.000824	.000367	.001280
.130	.000243	.000109	.000378	.290	.000543	.000242	.000844	.450	.000843	.000376	.001309
.140	.000262	.000117	.000407	.300	.000562	.000251	.000873	.460	.000861	.000384	.001338
.150	.000281	.000126	.000436	.310	.000581	.000259	.000902	.470	.000880	.000392	.001368
.160	.000299	.000134	.000465	.320	.000600	.000267	.000931	.480	.000898	.000401	.001397
.170	.000318	.000142	.000495	.330	.000618	.000276	.000960	.490	.000917	.000409	.001426
.180	.000337	.000151	.000524	.340	.000636	.000284	.000989	.500	.000936	.000418	.001455
.190	.000356	.000159	.000553	.350	.000655	.000293	.001018	.510	.000955	.000426	.001484
.200	.000375	.000167	.000582	.360	.000673	.000301	.001047	.520	.000973	.000435	.001513
.210	.000394	.000176	.000611	.370	.000692	.000309	.001076	.530	.000992	.000443	.001542
.220	.000413	.000184	.000640	.380	.000711	.000318	.001106	.540	.001010	.000451	.001571
.230	.000431	.000192	.000669	.390	.000730	.000326	.001135	.550	.001029	.000459	.001600
.240	.000450	.000201	.000698	.400	.000749	.000334	.001164	.560	.001048	.000468	.001629

INTERPOLATION TABLE

Add'l. Wt.	Add'l. K	Add'l. M	Add'l. C	Add'l. Wt.	Add'l. K	Add'l. M	Add'l. C	Add'l. Wt.	Add'l. K	Add'l. M	Add'l. C
.001	.000002	.000001	.000003	.004	.000007	.000003	.000012	.007	.000013	.000006	.000020
.002	.000004	.000002	.000006	.005	.000009	.000004	.000015	.008	.000015	.000007	.000023
.003	.000006	.000003	.000009	.006	.000011	.000005	.000017	.009	.000017	.000008	.000026

For method of interpolation see Data Sheet No. 129.

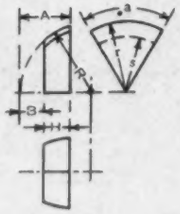
DATA SHEET No. 169, THE FOUNDRY, Sept., 1914.

FORMULAE FOR FINDING THE WEIGHTS OF CASTINGS

By W. L. Tryon

To find the weight of a sector of a spherical segment of one base, multiply the difference between the radius of the sphere and one-third of the height by the height squared by the number of degrees in the angle by k, or to the radius of the base squared multiplied by the height by the number of degrees in the angle by m, add the height cubed multiplied by the number of degrees by c.

$$W=(R-\frac{H}{3})H^2ak \text{ or } W=r^2Ham+H^3ac$$



To find the weight of a sector of a spherical segment of two bases, from the difference between the squares of the distances from the bases to the pole multiplied by the radius of the sphere by the number of degrees in the angle by k, subtract the difference between the cubes of the distances from the bases to the pole multiplied by the number of degrees by C, obtained from preceding Data Sheet, or to the sum of the squares of the radii of the bases multiplied by the height by the number of degrees in the angle by m, add the height cubed multiplied by the number of degrees in the angle by c.

$$W=(A^2-B^2)Rak-(A^3-B^3)aC \text{ or } W=(r^2+s^2)Ham+H^3ac$$

ALL DIMENSIONS IN INCHES AND WEIGHTS IN POUNDS

Wt. per cu. in.	k	m	c	Wt. per cu. in.	k	m	c	Wt. per cu. in.	k	m	c
.096	.00084	.000419	.000140	.250	.00218	.001092	.000363	.410	.00358	.001789	.000596
.100	.00087	.000436	.000145	.260	.00227	.001135	.000378	.420	.00367	.001833	.000611
.110	.00096	.000480	.000160	.270	.00236	.001179	.000393	.430	.00375	.001876	.000625
.120	.00105	.000524	.000174	.280	.00244	.001223	.000407	.440	.00384	.001920	.000640
.130	.00113	.000567	.000189	.290	.00253	.001266	.000421	.450	.00393	.001964	.000654
.140	.00122	.000611	.000203	.300	.00262	.001309	.000436	.460	.00401	.002008	.000669
.150	.00131	.000655	.000218	.310	.00271	.001353	.000450	.470	.00410	.002052	.000684
.160	.00140	.000698	.000233	.320	.00279	.001397	.000465	.480	.00419	.002095	.000698
.170	.00148	.000742	.000247	.330	.00288	.001440	.000480	.490	.00428	.002139	.000712
.180	.00157	.000786	.000261	.340	.00297	.001483	.000495	.500	.00436	.002182	.000727
.190	.00166	.000830	.000276	.350	.00305	.001527	.000509	.510	.00445	.002226	.000741
.200	.00175	.000873	.000291	.360	.00314	.001571	.000524	.520	.00454	.002270	.000756
.210	.00183	.000917	.000305	.370	.00323	.001615	.000538	.530	.00463	.002313	.000770
.220	.00192	.000961	.000319	.380	.00332	.001659	.000553	.540	.00471	.002356	.000785
.230	.00201	.001004	.000334	.390	.00340	.001702	.000567	.550	.00480	.002400	.000800
.240	.00209	.001048	.000349	.400	.00349	.001745	.000582	.560	.00489	.002443	.000815

INTERPOLATION TABLE

Add'l. Wt.	Add'l. k	Add'l. m	Add'l. c	Add'l. Wt.	Add'l. k	Add'l. m	Add'l. c	Add'l. Wt.	Add'l. k	Add'l. m	Add'l. c
.001	.00001	.000004	.000001	.004	.00003	.000017	.000006	.007	.00006	.000031	.000010
.002	.00002	.000009	.000003	.005	.00004	.000022	.000007	.008	.00007	.000035	.000012
.003	.00003	.000013	.000004	.006	.00005	.000026	.000009	.009	.00008	.000039	.000013

For method of interpolation see Data Sheet No. 129.

DATA SHEET No. 170, THE FOUNDRY, Sept., 1914.

Maximum Production in a Minimum Floor Space

Foundry of Ford Motor Co. Operated on the Continuous Plan Turns Out a Tremendous Tonnage at Remarkably Low Cost

By H Cole Estep

AMONG the many efficiently operated foundries in this country, the casting plant of the Ford Motor Co., Detroit, stands pre-eminent. The Ford shop turns out a simplified, specialized product in enormous quantities and is backed by practically unlimited capitol. This condition permits the management to take full advantage of the economies resulting from a minute subdivision of labor and the employment of machinery for all operations except those in which hand labor is practically indispensible. Ford methods which have been adopted must necessarily be interesting to every foundryman who wishes to make good gray iron castings at minimum cost.

The Ford foundry makes only gray iron and aluminum castings. The product includes cylinders, cylinder heads, pistons, piston rings, manifolds for intake and exhaust, flywheels, magneto spool supports, brake bands, circulating water connections, etc., in gray iron and transmission case covers, commutator covers, etc., in aluminum.

The Ford factory has a maximum capacity at present of 1,200 cars per day, requiring 1,200 cylinder sets, 4,800 pistons, 1,200 flywheels, 1,200 exhaust manifolds, 1,200 intake manifolds, and equally large quantities of brake bands, water conections, etc. The Ford foundry is practically equal to this enormous demand, although when the stress is specially severe some work is done outside at another plant controlled by the Ford company.

To give a clear idea of what the production suggested above really means, the following figures are submitted. When operating at full capacity, the Ford foundry melts from 190 to 200 tons of pig iron daily. In the ten months and three days, from Oct. 1, 1913, to Aug, 4. 1914, the Ford foundry melted 63,184,530 pounds of iron, or 31,592 net tons. During the same period 38,056,220 pounds of castings were shipped, or 19,028 net tons. The average melt for the 260 working days under consideration was a little over 121 tons per day and the average shipments were 73¼ tons per day. From these figures it is seen that the weight of the finished castings averages 60.3 per cent of the weight of the total amount of iron melted. The foundry handles a total 1,482 tons of molding sand every eight hours.

Further figures regarding the work done on selected days are interesting. For instance, on April 14, 1914, 295,480 pounds of iron were melted and 206,762 pounds of castings were shipped. On the same day 46,910 pounds of coke and 10,465 pounds of limestone were consumed. On Aug. 4, 1914, 211,200 pounds of iron were melted and 164,900 pounds of castings shipped. On Aug. 4, 1914, 110 carloads of pig iron were on hand in the yard, equivalent

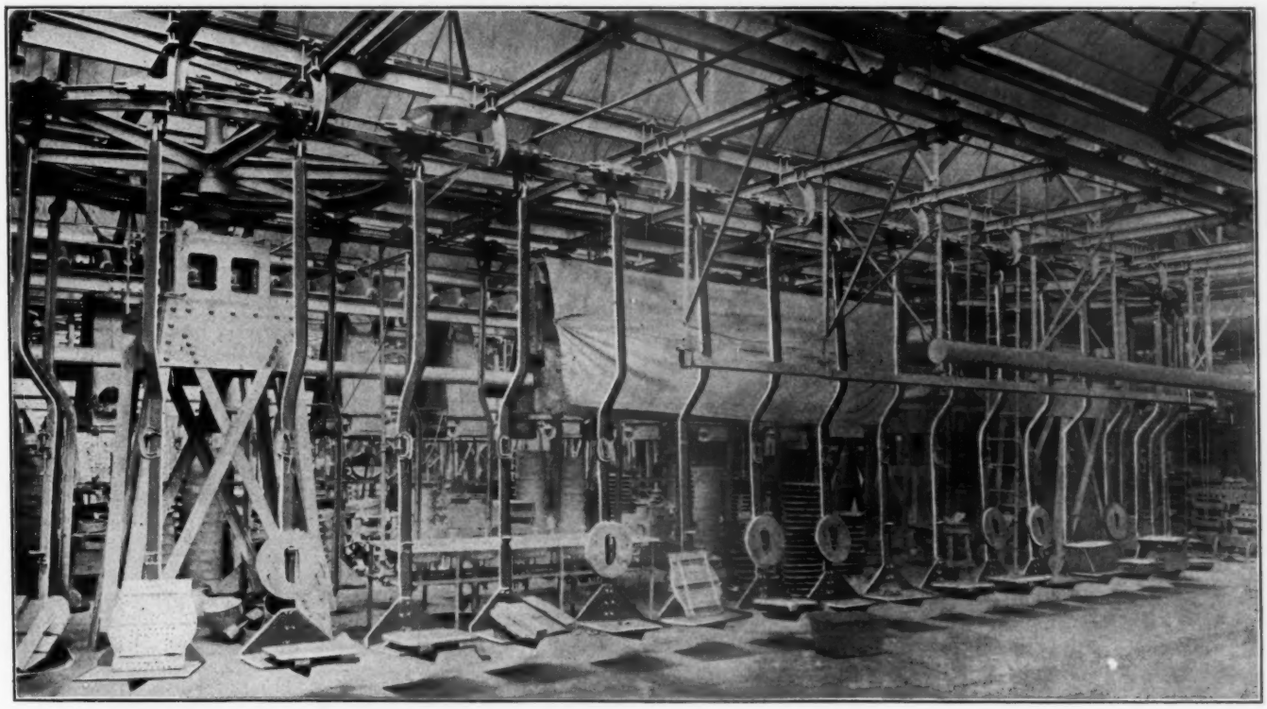


FIG. 1—CONTINUOUS MOLD CONVEYOR IN FORD MOTOR COMPANY'S FOUNDRY

ods are unique and in studying the Ford foundry it is difficult to find an adequate basis for comparison. The Ford shop stands alone not only as compared with other automobile foundries, but many other foundries as well. In no other plant in the country can be found a duplicate of the conditions which have made the Ford foundry what it is, but nevertheless, the foundry problems encountered by the Ford company are sufficiently parallel to those confronting other manufacturers of specialized machinery to be worthy of special study and the meth-

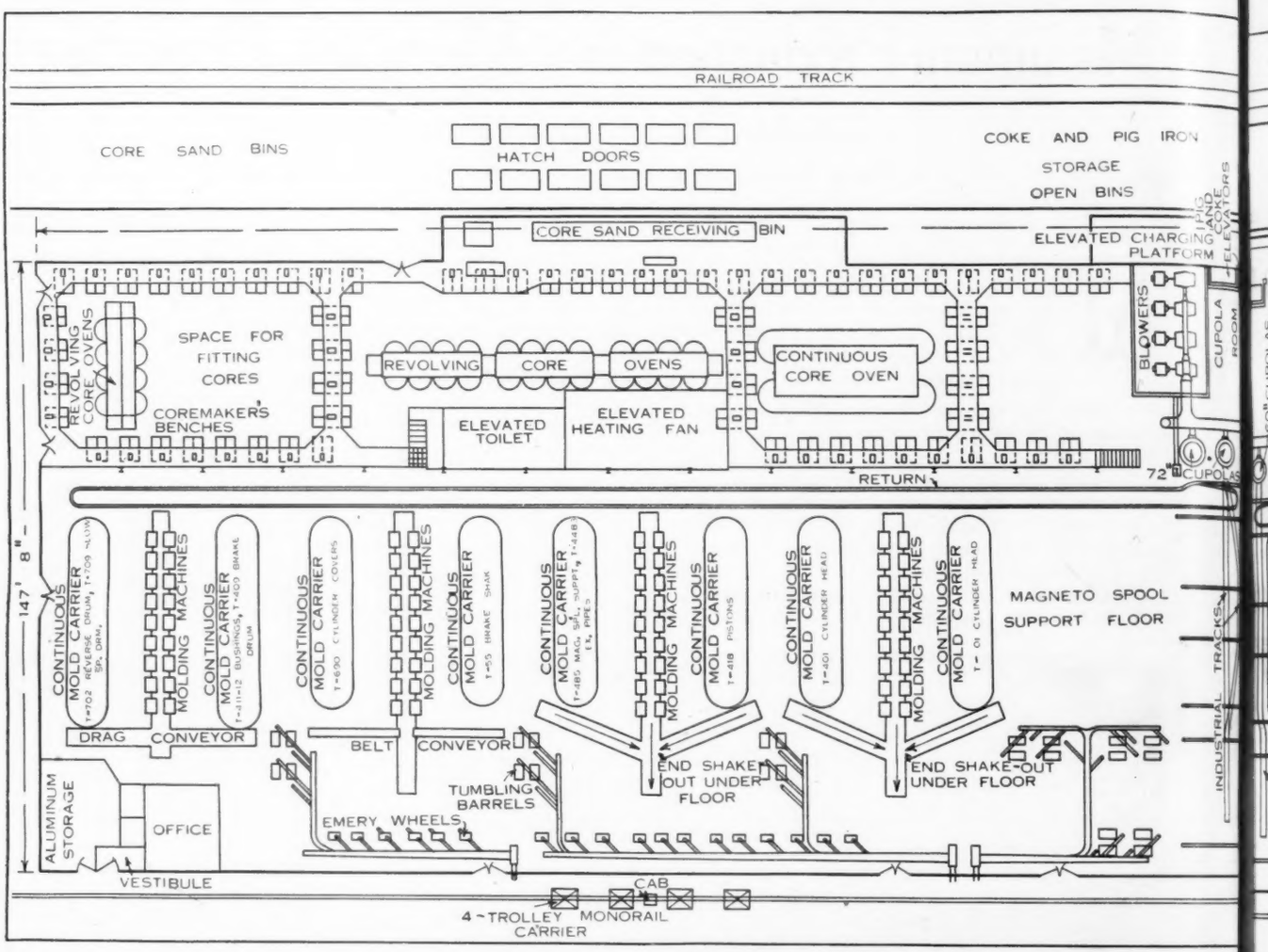


FIG. 2—GENERAL PLAN OF FOUNDRY OF FORD MOTOR CO.

to about 5,000 tons. The Ford company does not aim to keep extensive stocks of pig iron on hand; only sufficient iron is carried to prevent a shut-down in case of unusual traffic delays. The rather high ratio of iron melted to castings shipped is accounted for by the fact that the gates and sprues on much of the small work necessarily weigh as much as the castings themselves and this counterbalances the comparatively light sprues and gates on the cylinders and other heavy work.

In order to handle an exceptionally large output economically, the Ford company has been justified in making unusually heavy expenditures for machinery, equipment, patterns, core boxes, etc. In order to withstand the tremendous wear, practically all of the patterns and core boxes are made of cast iron and a large number of highly skilled workmen are constantly employed in making new patterns and keeping the old ones in order. As an example of the heavy investments which have been made in equipment, it may be stated that certain cast iron

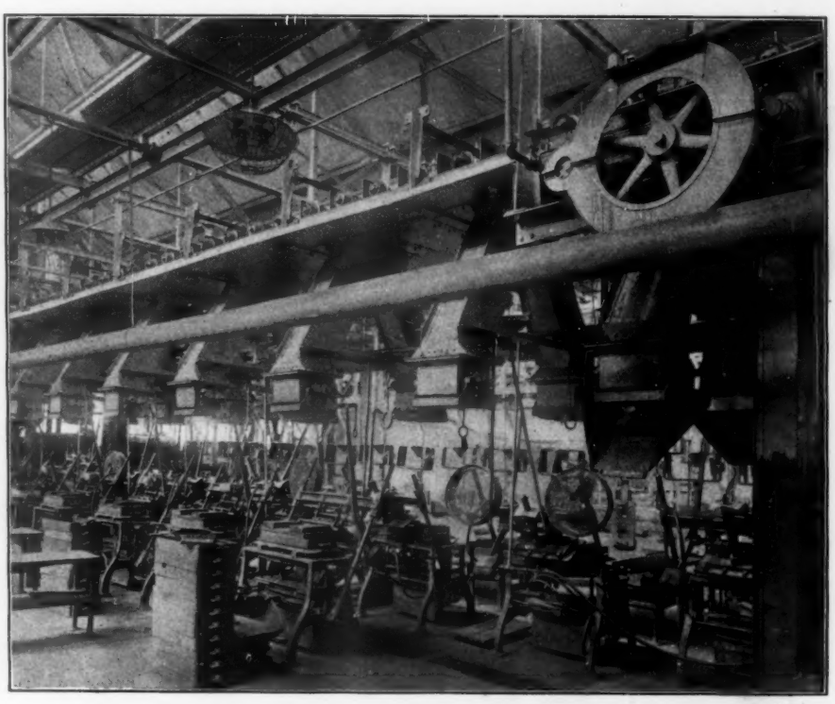
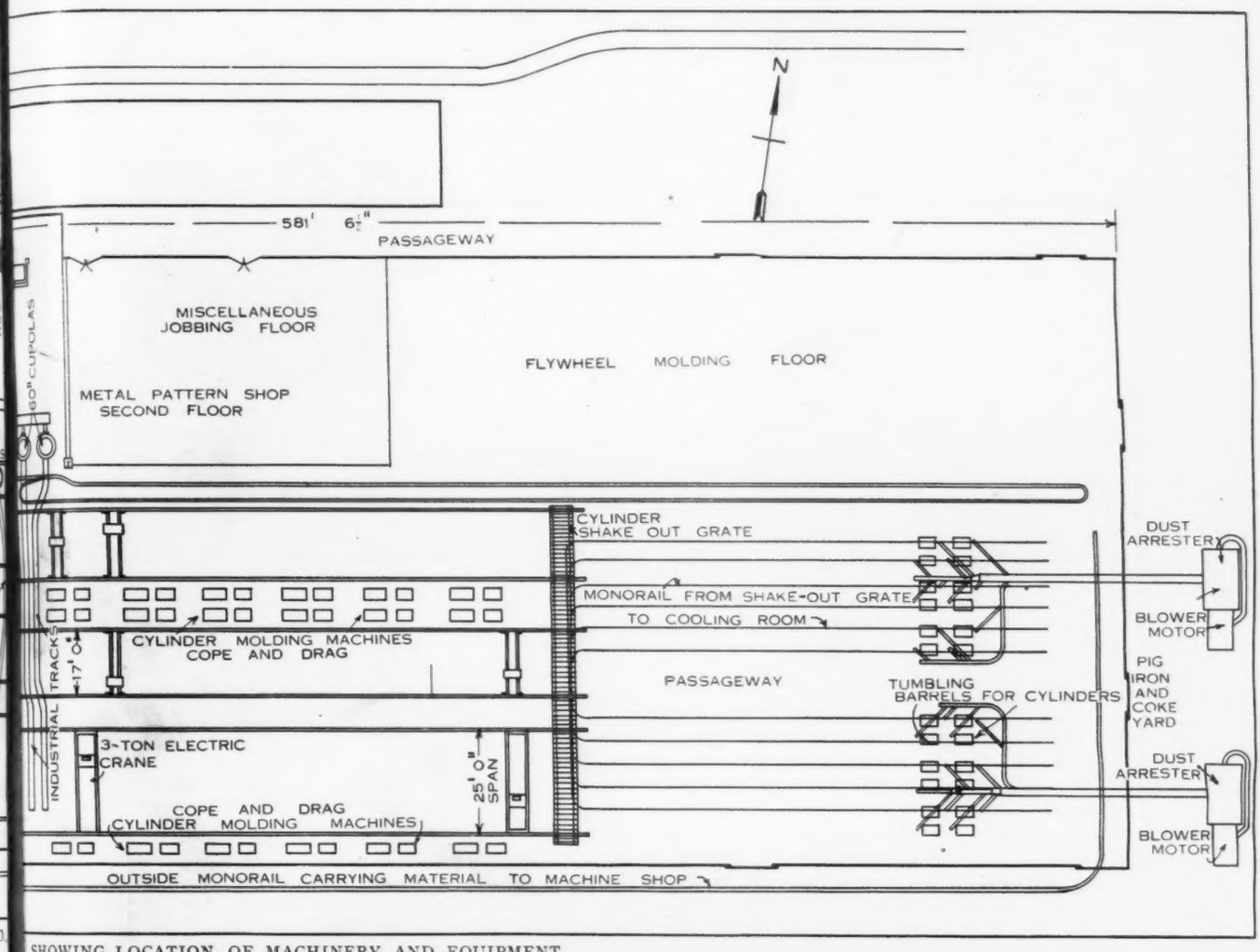


FIG. 3—MOLDING MACHINES IN PLACE UNDER SAND CHUTES



SHOWING LOCATION OF MACHINERY AND EQUIPMENT

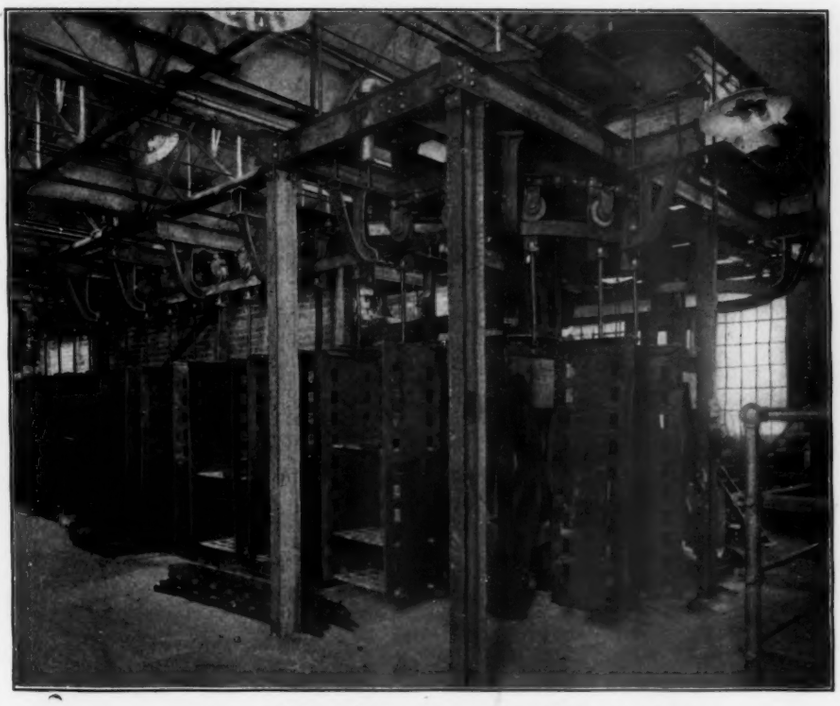


FIG. 4—CONTINUOUS OIL-FIRED CORE OVEN

core dryers used in making the cylinder cores cost $20 each, and 200 are required.

The Ford foundry is operated on the continuous system and the core-making, molding, melting, shaking-out, sand-handling and cleaning operations proceed uninterruptedly through the day. As is well known, the Ford shop runs on an eight-hour schedule, the day shift in the foundry commencing at 6:30 in the morning and quitting at 3:00 p. m., with half an hour for lunch, between 10:30 and 11:00 a. m.

Molding machines of standard manufacture are utilized and special equipment for handling metal, sand and molds, in order to obtain a maximum production in a minimum floor space, has been provided. The molds for the various small parts are handled on specially-designed, endless conveyors, provided with individual sand-handling and cleaning units; the cylinders are made on molding machines, poured on the floor and the metal, hot castings and sand are handled by a special system of traveling cranes.

Naturally, in a shop of this character the problem of economically handling large quantities of materials is paramount, and in order to reduce to a minimum the distance over which any piece must be handled, each unit in the foundry is complete in itself, including apparatus for shaking out the molds, cutting over the sand and cleaning the castings. There is no cleaning room, in the ordinary sense of the word, in the Ford foundry; batteries of tumblers are operated in connection with each of the molding units and are situated as close as possible to the point where the molds are produced. All of the work is cleaned in tumbling mills, including the cylinders and the sand blast is not employed. As a further example of the concentration of facilities, it may be mentioned that space in the center of some of the mold conveying units has been utilized for the installation of an overhead monorail. The raw materials enter at the north side of the building, flow across the shop in the shortest direction in the processes of manufacture and the finished product is shipped out over a monorail, which parallels the south side of the building. A four-trolley Pawling & Harnischfeger electric telpher is operated on the monorail. Its general arrangement is clearly indicated in Fig. 2 and also in Fig. 7.

Every Square Foot Utilized

The four cupolas are located in the north bay in the middle of the shop and the iron is distributed over two monorail loops, which extend in each direction from the cupolas. The core room is situated in the northwest corner of the building, occupying a space about 50 feet in width and 265 feet in length. The remainder of the west half of the shop is taken up by wash basins, clothes racks and other toilet facilities.

The plan, Fig. 2, shows the general arrangement of the Ford foundry. The building is of steel and concrete construction, one story in height, with a saw-tooth roof. It is practically 582 feet in length and 148 feet in width. North of and parallel to the building are a series of concrete bins for storing core sand, pig iron, coke, etc. The sand is stored under cover. These bins are served by a 3-ton Shaw gantry crane, equipped with buckets and a magnet for transferring iron and coke direct to the charging platform or for shifting core sand from the storage bins to the overhead service bin in the foundry. East of the foundry is a large yard for storing surplus pig iron, scrap, coke, molding sand, etc. This yard is traversed by a standard gage track and also by the four continuous molding units. The eastern half of the floor is devoted to cylinder and flywheel molding and jobbing work. The total floor space occupied, including the core-making department, is about 86,300 square feet, or approximately 453 square feet per ton of iron melted, assuming a maximum melt of 190 tons daily. Based on the average melt of the part ten months, 121 tons daily, 710 square feet per ton are required. These figures throw an interesting light on the efficiency with which the space in the Ford foundry is utilized. Carefully prepared figures published in THE FOUNDRY, May, 1913, showed that automobile, agricultural implement and similar shops having large quantities of light duplicate castings require from 550 to 988 square feet of floor space per ton of iron melted daily, the average of the existing shops of this character in the United States being 756 square feet per ton. The high output per square foot of floor space obtained in the Ford shop, where light castings form the bulk of the tonnage, is due almost entirely to the concentration resulting from the employment of continuous methods for handling practically all of the work.

As previously mentioned, the small parts are molded on specially designed continuous units, of which four have been installed. As indicated in Fig. 2, units Nos. 1 and 2 are similar in design, while Nos. 3 and 4 are each somewhat different in their arrangement. The three types represented are the result of evolution and experience, the first two units having been installed during the first part of 1913, followed by unit No. 3 and later by unit No. 4, which has only been in operation a few months. Since unit No. 4 represents the latest ideas, it will be described in some detail. Elevation and plan of this unit are shown in Figs. 5 and 13, while Figs. 1, 3 and 8 illustrate various interesting features of the unit. This unit occupies an overall floor space about 60 feet square, or 3,600 square feet. The unit consists, as shown in the illustrations, of two endless mold conveyors, set parallel to each other on 41½-foot centers, with two endless sand conveyors arranged in the form of a T, the molding machines being located under one of the sand conveyors in the space between the mold carriers. Space is provided for 20 molding machines and at the present time the unit is used for molding exhaust and intake manifolds and requires about 25 tons of iron per eight hours. Hand-operated squeezer machines are employed. Thirty-six tons of sand per hour pass through the

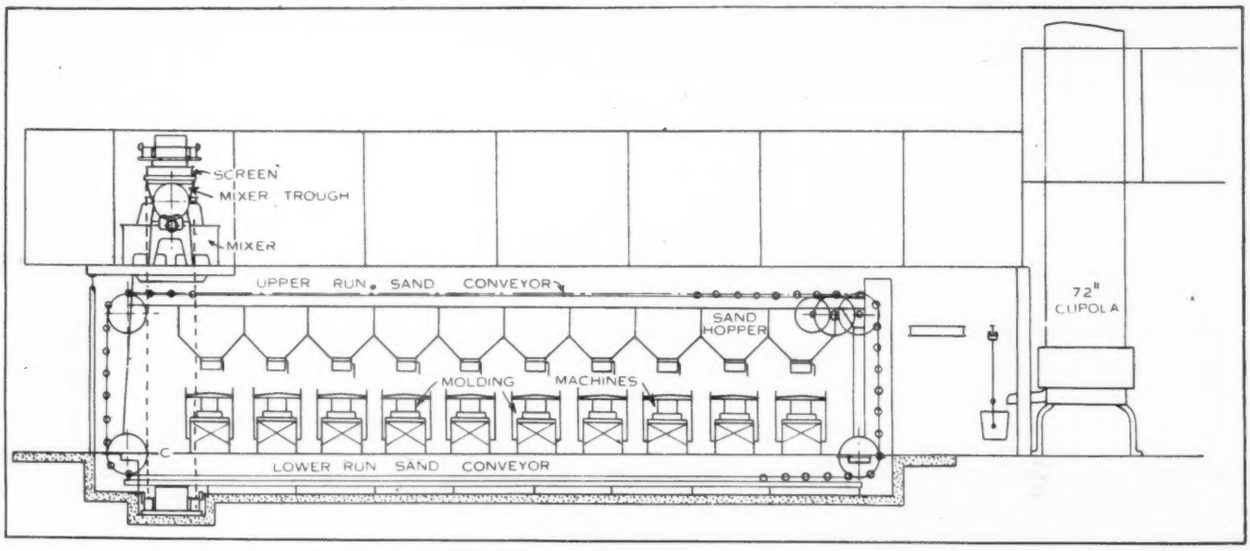


FIG. 5—ELEVATION OF CONTINUOUS MOLDING UNIT

FIG. 6—BATTERY OF FOUR CUPOLAS IN MELTING DEPARTMENT

system, or 288 tons in an eight-hour shift.

The upper run sand conveyor, shown in Fig. 5, distributes the prepared molding sand into a series of ten steel bins, each of which is provided with two chutes. The 20 molding machines are located directly under these chutes. As fast as the molds are made, they are placed on the endless conveyors, which move in the directions shown by the arrows in Fig. 13, at the rate of about 12½ feet per minute. A record of the work accomplished by each man during the day is obtained by means of brass checks, which are placed on the molds as they are started toward the pouring station. This record of production is kept simply for purposes of comparison and discipline, all of the men in the Ford shop being paid on a day rate basis.

As the molds go around the outer end of the conveyor, next to the hot metal track, they are poured. The actual pouring is done with small trolley ladles, which are operated by hand on a subsidiary monorail that parallels the track of the mold conveyors, as shown in Fig. 13. The pouring ladles are replenished from time to time by the bull ladles, which are operated on the monorail connected with the cupolas. About 3½ minutes are allowed for cooling the molds, at the end of which period they reach the shaking-out end of the conveyor.

As shown in Fig. 13, the molds are removed from the carrier at this point and are shaken out over a grating, through which the sand falls onto the cross conveyor, *D*. This conveyor is of the drag type and is so arranged that it carries the sand up to the receiving hopper of the mixer shown in Fig. 5. The necessary amount of new sand is added by dropping it through the grate with the old sand.

The sand mixer for unit No. 4 was designed by the Ford company and consists of a rotating or sifting unit of the usual type and a paddle mixer, which thoroughly incorporates the

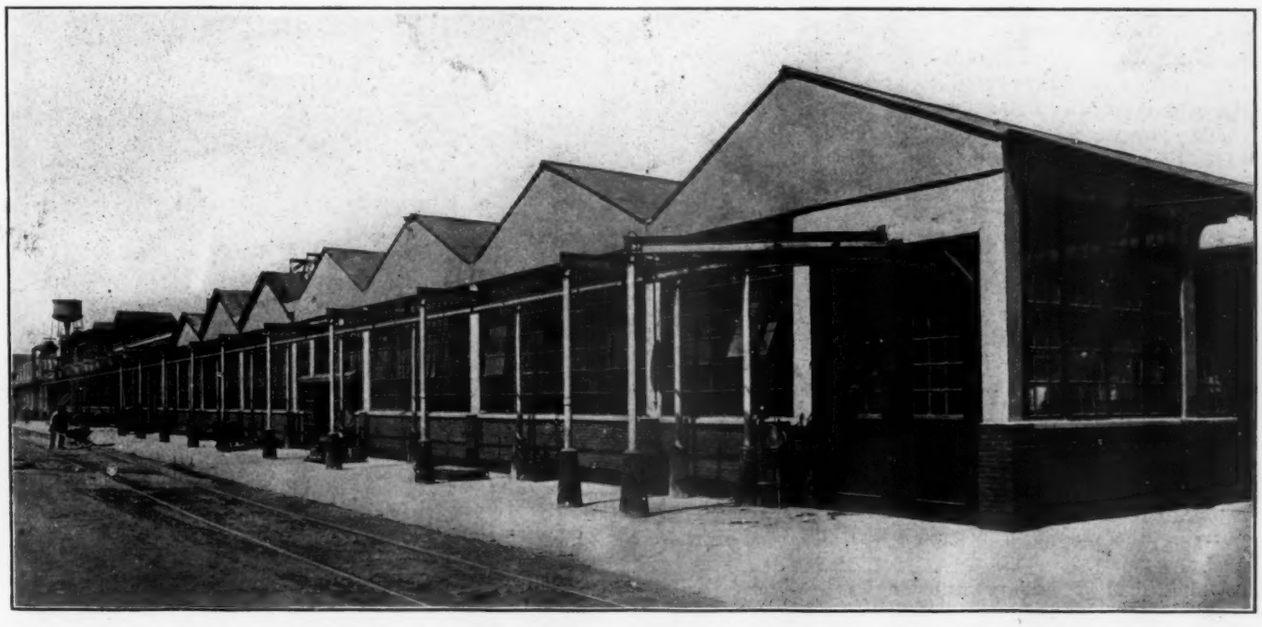


FIG. 7—SOUTH ELEVATION OF FORD FOUNDRY, SHOWING MONORAIL FOR DELIVERING CASTINGS TO THE MACHINE SHOP

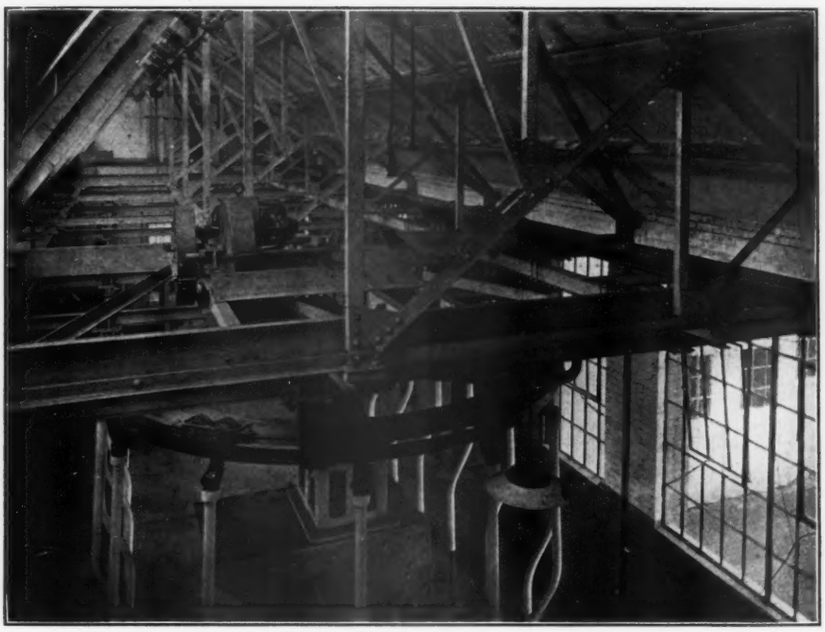


FIG. 8—DETAILS OF MOTOR DRIVE OF MOLD CONVEYOR

various ingredients of sand. The prepared sand drops from the mixer onto the upper run conveyor, from which it is returned to the bins over the molding machines. The latter conveyor carries the surplus sand around to the point *C*, Fig. 5, where it is dumped onto the cross conveyor and returned to the mixer. At the same time the lower run of this conveyor collects the surplus sand from the molding machines, which falls through gratings in the floor, and returns it also to the mixer by means of the cross conveyor.

The castings with their sprues and gates attached, which are retained on the grating when the molds are shaken out, are transferred by laborers to the tumbling mills operated in connection with the unit. From the mills the castings are transferred to grinding wheels and from the latter to the casting inspectors and then to the yard monorail for shipment to the machine shop. The number and arrangement of the tumbling mills and grinding wheels are shown clearly in Fig. 2.

The surplus iron from the pouring ladles is collected in iron pig molds, which are located on the floor convenient to each of the mold carriers.

Interesting Data

Although differing in detail, the general method of operating each of the four units is the same. Some interesting data, however, are available covering the operation of units Nos. 1, 2 and 3.

Unit No. 1 is used principally for molding cylinder end covers, water inlet connections, intake pipes and brake shoes. Two sets of molding machines are employed on cylinder end covers, one set on water inlet connections, two sets on intake pipes and four sets on brake shoes. The number of molds made in eight hours by one set of machines on each of the foreging four classes of work, are respectively, 400, 280, 550 and 480 molds. There are two cylinder end cover castings in each mold, weighing eight pounds. The flask weighs 46 pounds and the sand 103 pounds, the total weight of each mold, therefore, being 157 pounds. There are eight water inlet connection castings in each mold weighing 12 pounds. The flask weighs 46 pounds and the sand 103 pounds, as in the case of the cylinder end cover, and the total weight of the mold is, therefore, 161 pounds. There are two intake pipe castings in each flask weighing 13 pounds. The flask itself weighs 46 pounds and the sand 97 pounds, the total weight of each mold being 156 pounds. This means that for the intake pipe molds alone, 180,000 pounds of material must be transferred daily, amounting to nearly 90 tons. There are two brake shoe castings in each mold, weighing five pounds. The flask in this case also weighs 46 pounds and the sand weighs 76 pounds, the total weight of each mold being 130 pounds.

Production of Unit No. 1

The total production of unit No. 1 in eight hours is 4,100 molds, for which 16.82 tons of iron are required and 384 tons of sand are handled. Inasmuch as this unit occupies approximately 3,600 square feet of floor space, it is seen that the concentration is very great, there being only 214 square feet of floor space utilized per ton of iron handled daily. This is less than one-third of the average value quoted above for other foundries in the United States handling a somewhat similar class of work. Even with core room space added, the figures are equally surprising. The nine Berkshire molding machines operated in connection with unit No. 1 make an average of 460 molds per machine per day (eight hours), pro-

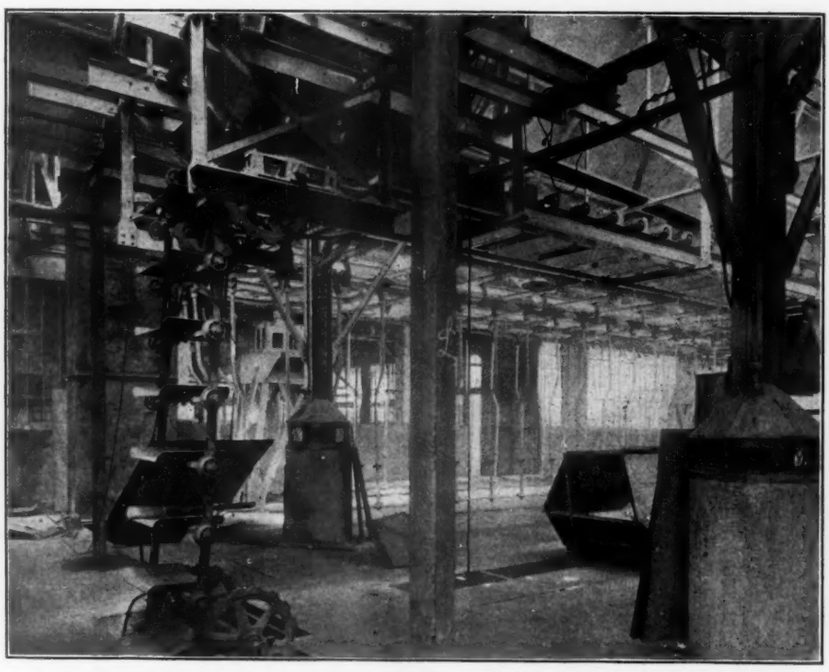


FIG. 9—SAND ELEVATOR AND CONVEYOR IN PARTIALLY COMPLETED CONDITION

ducing a total of 10,000 castings with an average weight of 3.6 pounds each. Forty-two men are employed to operate the unit. The figures regarding floor space previously given, it should be explained, are based on the overall floor space occupied by the unit, which includes half of the space between adjacent units and portions of the space required for the tumblers, etc. The net floor space occupied by the unit is 3,000 square feet and on this basis only 178 square feet are required for each ton of iron handled per eight hours.

Concentrated Production

Unit No. 2 is utilized principally for making three parts, including exhaust pipes, magneto spool supports, and pistons. The latter are molded on machines of a special design and no dry sand cores are used. The core is formed in green sand as a part of the drag. In addition to the reduction in cost owing to the elimination of dry sand cores, it is said that pistons molded in green sand are more uniform both as regards total weight and thickness of walls, factors which have a very important bearing on the smoothness with which the engine operates. Two sets of molding machines in unit No. 2 are used for making exhaust pipes, four sets for making magneto spool supports and five sets for making pistons. The capacity of each set is, respectively, 280, 250 and 160 molds per eight hours There are two exhaust pipe molds in each flask weighing 14 pounds. The flask weighs 66 pounds and the sand 151 pounds, the total weight of the mold being, therefore, 231 pounds. One magneto spool support, weighing 11 pounds, is made in each flask. In this case the flask weighs 55 pounds and the sand 105 pounds, the total weight of the mold being 171 pounds. The four sets of machines employed on this job make 1,000 molds per day. Four pistons weighing 25 pounds are made in each mold. The flask weighs 53 pounds and the sand 114 pounds, the total weight of each piston mold being 192 pounds. Five sets of machines make 800 molds per day of eight hours, requiring the handling of approximately 153,600 pounds of material.

FIG. 11—REEL TYPE CORE OVENS FOR BAKING MANIFOLD CORES, CYLINDER BARREL CORES, ETC.

FIG. 10—FITTING AND ASSEMBLING CYLINDER CORES

Unit No. 2 turns out a total of 2,360 molds per eight hours, requiring 20½ tons of iron. Thirty-four tons of sand are handled per hour, or 272 tons in eight hours. There are 4,000 castings in the 1,000 piston molds made each eight hours and 6,000 castings of an average weight of 6.8 pounds each in the total eight-hour production of unit No. 2. Fifty-seven men are employed to operate the unit and the floor space is similar to that required for unit No. 1. The ratio of floor space to output is somewhat less than in the case of unit No. 1 on account of the fact that more iron is handled per day.

Output of Unit No. 3

Unit No. 3 is employed exclusively for molding cylinder heads, eight sets of machines being used. Each set turns out 180 molds per day, or a total of 1,440 molds in eight hours. There is one casting in each mold weighing 35 pounds. The flask weighs 88 pounds and the sand 216 pounds, the aggregate weight of each mold being 339 pounds. This unit requires 25 tons of iron and 288 tons of sand per eight hours. Fifty-six men are employed and the floor space is similar to that required for units Nos. 1 and 2. Using the net figure of 3,000 square feet, this unit has only 120 square feet per ton of iron handled per eight hours; using the overall figure of 3,600 square feet, the ratio is increased only to 144 square feet per ton of iron. This figure is only 19 per cent on the average figure, 756 square feet, previously quoted. These data indicate that the Ford company ob-

tains about five times the average output from the floor space occupied by unit No. 3.

The methods employed in molding cylinders are no less interesting than those previously described. The cylinder floor, including the cleaning department connected therewith, is approximately 285 feet in length and 90 feet in width. It is laid out substantially as indicated in Fig. 2. The molding floor proper is served by three parallel crane runways, carrying three-ton electric traveling cranes, which are used for handling the sand, molds, iron, etc. Two of the runways are 17-foot span each and the third is 25-foot span. The molding machines are arranged in rows between the two 17-foot runways and between the 25-foot runway and the south wall of the building, as indicated in Fig. 2; the space under the cranes is reserved for molds waiting to be poured.

Specially designed roll-over, drop molding machines are used. The machines are operated in pairs, one making the copes and the other the drags. The cylinder sets are molded horizontally in two-part flasks, the pattern being divided on a plane passing through the central axis of each cylinder. Dry sand cores, which have been previously fitted and assembled are delivered to the cylinder floor for insertion in the molds. Eleven sets of cylinder molding machines are operated, each with a capacity of 95 molds per eight hours. There is one casting in each mold, weighing 125 pounds. The flask weighs 162 pounds and the sand 478 pounds, the total weight per mold being 785 pounds. The aggregate capacity of the cylinder floor is 1,045 molds per day of eight hours, requiring 65.31 tons of iron. The cylinder molding department uses 31¼ tons of sand per hour, or 250 tons in eight hours. One hundred and fifty molders and helpers are employed in the cylinder department. The molding floor occupies 12,000 square feet, there being 185 square feet per ton of iron handled daily.

As fast as the cylinder molds are made, they are set on the floor under the crane runways, where they are poured. After allowing a suitable time for the metal to solidify the hot molds are picked up by the cranes and carried down to the shakeout grating, which divides the molding floor from the cleaning department. The sand falls through the grating into a trough underneath, from which it is removed, tempered and returned to the molding floor.

Several light monorail tracks extend from the shake-out grating to the tumbling mills in the cylinder cleaning department, as indicated in Fig. 2. The hot castings are removed from the grating by trolleys running on these monorails and are deposited in the space in front of the tumbling mills, where they are allowed to cool slowly over night. During the following day they are removed from the cooling floor and put through the mills, of which there are 24. The tumbling mills are arranged in two groups, each of which is connected to a dust exhaust system, as shown in Fig. 2. The castings are packed into the mills carefully and there has been no trouble due to breakage in rumbling. The internal cores in the cylinder castings are removed largely by the use of compressed air. After they are finished, the cylinder castings are shipped to the machine shop on the monorail, which enters the foundry at the extreme eastern end.

The flywheels are molded on the floor in the northeast corner of the shop, as indicated in Fig. 2. A portion of the space in this part of the shop is also used for general jobbing work. There is a large amount of this work going through the plant at all times, inasmuch as the Ford company builds a good many of its own machine tools.

Form 870

CUPOLA REPORT Feb. 28, 1914

	1	2	3	TOTALS
LIGHTED	4:50 A.M.	5:00 A.M.	7:00 A.M.	
BLAST	6:40	7:50	8:40	
IRON AT	7:00	8:10	9:00	
DROPPED	3:20	4:45	4:45	
	8¼	8½	7¾	
COKE BED.	=1600	=1600	=860	
COKE BET. CHGS.	230# 20375	175# 15925	10650	
TOTAL	21,975	17,525	11,510	51,010
Dia. inside lining	51"	42"	41"	
LIMESTONE	5425	3045	2345	10,815
FLUOR SPAR	620	—	—	620
TONNAGE 164½ CHGS.	82½	46	36	164½
Melting rate per hour	10	5.6	5.0	

NOTE Cylinders poured at average of 2460° Fahr.

FOREMAN

FIG. 12—CUPOLA REPORT FOR FEB. 28, 1914

Metal Pattern Shop

In a room 50 x 80 feet in size, located on a mezzanine floor over a portion of the jobbing floor, there is found the metal pattern shop. This shop is equipped with large number of modern machine tools for making metal patterns and 75 men are employed constantly. As previously stated, practically all of the patterns, core boxes and core dryers are made of cast iron in order to withstand wear.

As might be expected, the core department is an important feature of this foundry. It occupies a space of practically 13,200 square feet in the northwest corner of the building. The work is handled continuously and the general principles of operation are similar to those followed in the molding department. The core sand is transferred from the covered concrete bins outside to an overhead receiving bin by the gantry crane. The receiving bin is located on a gallery, which extends over the coremakers' benches, as indicated in Fig. 2.

From this bin the sand is transferred in buggies to two standard rotary type mixers, from which it is carried away in buggies and distributed to chutes leading to the coremakers' benches underneath the gallery. The men work in gangs and the actual work of making the cores is carefully subdivided so that each man performs only one elementary operation. Each core box, therefore, passes through several hands before the core is entirely completed. The cylinder barrel cores, for instance, are made of collapsible cast iron boxes, consisting of four sides and a bottom plate and two aluminum throat pieces, which are placed in the box at the junction between the cylinder and the upper half of the crank-case. The throat pieces are removed from the core after the four sides of the box are taken away. The men making the barrel cores work in gangs of three and a special man also is provided for spraying and transferring the completed cores.

Two types of oven are employed, the continuous type and the ordinary reel type. A large number of the latter are located at convenient points

throughout the core room, as shown in Fig. 2.

The continuous oven, some of the features of which are shown in Figs. 2 and 4, has been in operation for only a short time and has a large number of interesting features. The cores are carried on a system of racks or shelves suspended from trolleys run on an endless, looped monorail. The trolleys are connected together in the form of an endless chain, so that the whole system moves together. Half of the train is constantly in the oven and the other half is outside. The cores are placed on the shelves while they are outside the oven and are baked while passing through from one end to the other. The oven is fired by fuel oil and two trains of core carriers are operated continuously. The smaller cores are handled by one train and the larger ones by the other, which moves slower. The small core train has a speed of approximately 12 inches per minute and the large core train a speed of approximately 7 inches per minute. A temperature of 525 degrees Fahr. is maintained in the oven and the large cores are baked for about one hour and ten minutes and the smaller ones for 45 minutes. Each core train is driven by an electric motor through a double spur gear and double worm gear reduction. The cylinder barrel cores are baked almost entirely in the reel ovens, where they are subjected to a heat of approximately 500 degrees for 2½ hours. Oil and core compound are used for binder.

Large Melting Capacity

In order to melt the large quantities of iron required daily, two 72-inch and two 60-inch cupolas are provided. They are located in a single battery in the middle of the shop, as indicated in the general plan, Fig. 2. The blast is furnished by four Sturtevant No. 10 blowers, each directly connected to a 40-horsepower motor. The blowers all feed into a common blast main, which in turn is connected to each of the cupolas. The blast piping is, therefore, as simple and as direct as possible and the blowers may be operated in any combination which is desired. The cupolas are charged by hand. The charging floor is ample in size and is connected with the main floor by two electric elevators. A portion of the charging floor extends outside the building under the gantry crane runway and considerable material is handled direct from incoming cars to the charging floor by means of this crane.

The heats are long, frequently extending slightly over eight hours. The cupolas are cleaned out every night and are slagged out frequently during the day. Cinder mills are not used for recovering the iron in the drop; instead a magnet is employed which gathers up most of the larger pieces. In order to indicate the length of the heats a portion of the cupola report for April 14, 1914, is given below:

	Cupola No. 1.	Cupola No. 2.	Cupola No. 3.
Lighted ...	4:30 a. m.	5:00 a. m.	5:00 a. m.
Blast	6:40 a. m.	7:55 a. m.	6:55 a. m.
Iron	7:00 a. m.	8:15 a. m.	7:15 a. m.
Dropped ..	3:15 p. m.	5:00 p. m.	5:00 p. m.

The mixtures are carefully controlled by analysis and consist of selected pig iron, scrap and from 10 to 15 per cent steel. The principle facts covering each day's heat are reported on the form shown in Fig. 12, which also gives the figures for Feb. 28, 1914. On this day it will be noted that three cupolas were operated. The 72-inch cupola melted at the rate of 10 tons per hour and the two 60-inch cupolas at the rate of about five tons per hour. The cylinders on this day were poured at an average temperature of 2,460 degrees Fahr.

The aluminum shop is located immediately west of the gray iron foundry. The equipment include six sets of Pridmore rock-over drop machines. These machines have a capacity of 110 transmission cover molds per eight hours. The six sets of machines, therefore, can turn out 660 molds in eight hours. The aluminum is melted in pit furnaces having a capacity of 18,000 pounds per 24 hours. An ordinary mixture, consisting of 92 per cent aluminum and 8 per cent copper.

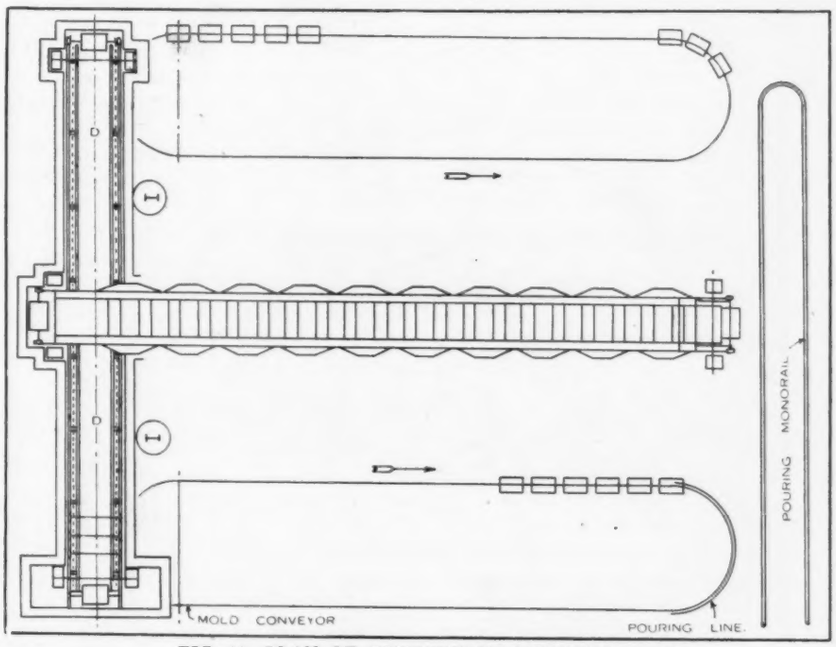


FIG. 13—PLAN OF CONTINUOUS MOLDING UNIT

is employed. The castings are finished on large disc grinding machines, which are located immediately adjacent to the molding floor.

No article on the Ford foundry would be complete without some reference to the Ford profit-sharing plan. The general features of this plan have been so widely exploited that it is unnecessary to go into any details here. The plan has now been in operation for about six months and its effect on the morale and efficiency of the working force has been all that could be expected. Before the plan was put into effect, one of the chief causes for diminished output in the foundry was the continual shifting in the personnel of the working force. As is usually the case in foundries, the men were constantly coming and going. Since the plan has been in operation, a good deal of this trouble has been eliminated and the men are much more anxious to hold their jobs than was formerly the case. Their general interest in their work also has been increased and the influence of the profit-sharing plan on the daily output per man is noticeable. In brief, the executives of the Ford company feel that the plan has been a success from every point of view. The eight-hour day has also proved successful, particularly in the foundry, where the output per hour has been appreciably increased.

The Wheeler foundry, 138 Mechanic street, Worcester, Mass., has been closed permanently. The old buildings, which were purchased by A. A. Wheeler, will be razed.

THE FOUNDRY

A monthly journal devoted to all branches of the foundry trade.

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Contents

The Foundry Convention at Chicago 327
American Foundrymen's Association Program 329
Program American Institute of Metals 331
Condensed Program of Chicago Convention 331
Exhibition of Foundry Equipment and Supplies 332
Car Wheel Mixtures 336
New Ingot Mold Plant 336
Electric Arc-Welding and Foundry Efficiency 336
Compressed Air as an Aid to Foundry Efficiency 337
Life of a Cupola Lining 342
Appoints Panama Agents 343
Current Foundry Inefficiencies and Practices 344
The Value of Saving Seconds in the Foundry 347
A Labor Leader's Viewpoint of Scientific Management 353
Solid Castings 354
A Two-Story Foundry for Pipe Fittings 355
Operating a Brass Foundry Under Difficulties 361
Melting and Casting Non-Ferrous Metal 362
New England Foundrymen's Meetings 366
Maximum Production in a Minimum Floor Space 367
Trade Outlook 376
The Chicago Convention 376
Adjustable Mold Jackets for Foundry Use 377
International Combination Molding Machine 379
Pridmore Combination, Jar-Ramming, Rock-Over Machine 380
Personals 381
General Industrial Notes 382
Trade Publications 382

The Chicago Convention

A FAIR measure of the importance of the approaching convention of the allied foundry associations at Chicago may be gathered from the fact that the American Foundrymen's Association alone will read and discuss over 40 papers and reports. This is a far greater volume of material than ever has been considered before by any of the allied societies. This, coupled with the fact that the exhibition of foundry and shop equipment at the International Amphitheatre promises to eclipse all previous efforts, makes it certain that the 1914 gathering of foundrymen in Chicago will be a notable one. Although owing to business conditions, the past twelve months have been trying to the foundry industry, nevertheless there have been noteworthy advances in foundry practice and important improvements in foundry machinery and equipment. The very lack of business and the consequent keenness of competition has compelled foundry managers in many cases to give thought to the employment of labor-saving machinery and methods which would not be given much consideration in more prosperous times. The results of this thought will appear at the convention and the foundryman who visits Chicago this year will be sure to come away with many valuable suggestions and ideas for improving his product and lowering his costs. The American Foundrymen's Association and the American Institute of Metals will hold eleven professional sessions at which a number of unusually important subjects will be considered. The Cost Congress, which will be held jointly by the A. F. A. and A. I. M. on Wednesday morning Sept. 9, bids fair to be alone worth the trip to Chicago.

Trade Outlook

BUSINESS conditions generally were unsettled throughout the month of August as a result of the European war and many purchases are being deferred until the affect of this world-wide trade disturbance is more clearly defined. The ultimate outcome foreshadows unparalleled prosperity for American industries and with the reestablishment of the trade routes to Europe and South America, our export trade should grow tremendously in volume. The temporary financial strain, following the first shock of the outbreak of the war, has been relieved almost entirely, and improved collections were reported during the last half of last month. The foundry melt is still below normal and in the New England states the output has been materially reduced by the closing of plants that have depended largely upon the export trade for the sale of their product. In the middle west, however, business conditions again are showing a slight improvement, and it is the prevailing impression that the buying movement cannot be deferred very long. Equipment manufacturers report the placing of numerous contracts and in several instances plants are being extended to increase the capacity. The buying of pig iron is limited largely to supplying immediate requirements and quotations in the leading centers follow: No. 2 northern, Chicago, $14; Pittsburgh, $13.90; Ironton, O., $13.50; Philadelphia, $14.50; Buffalo, $12.50 to $13; and Birmingham, $10 to $10.50. Malleable is quoted at $14 Chicago and $13, Buffalo, while basic is held at $13.90 Pittsburgh and $14 to $14.25, eastern Pennsylvania.

Adjustable Mold Jackets for Foundry Use

A New Cast Iron Snap Mold Jacket, Recently Designed, Which Effects Great Economies in Casting Manufacture

WE BEGAN using snap flasks in our foundry years ago when they first came out. It is admitted they have had certain limitations and disadvantages, and we have tried the various devices placed on the market at different times to remedy these. None of these quite met our needs; so for the past several years we have experimented and worked to perfect a mold jacket that would adjust itself to the sand mold after the flask had been removed and support the sand during the process of pouring and before the molten mass cools, as well as though the flask were allowed to remain on the mold. We think we have finally succeeded."

So spoke Chas. O. Wood, of the T. B. Wood's Sons Co., Chambersburg, Pa., in explanation of the automatic adjustable snap mold jacket which this concern has been using in its foundry for some time with considerable success.

Since the advent of the snap flask in molding there has existed a need for some device to support the weaker parts of the mold while it is being poured and before the metal has cooled, to assist the sand in withstanding the fluid pressure of the liquid mass. The existence of this pressure has placed large limitations on snap flask operation, as to weight of casting, depth and area of mold.

The need is simple enough. All that is required is something to replace the flask while the mold is being poured, but the satisfactory solution of the problem has been a different matter entirely. The device must support the sand at all points of the mold where a break with its attendant runout might occur, and also prevent "swelling". It must at the same time be easy to apply, light, simple, durable and in every way economical to operate or else it would at once defeat its own purpose and that of the snap flask as well to a certain degree. All foundrymen recognize the superiority of snap molding over molding with the regular type of floor flask. The work is lighter, the output greater and the castings are more accurate. This is the logical outcome of the use of equipment which is easier to handle and better adapted to the work. In snap molding the cope and drag fit together perfectly, as the pins are straight and true to size, and the fact that the rough handling due to shaking out is eliminated tends to keep them so.

Further, the snap flask may be replaced by a solid taper draw flask, using withdrawable sand strips in the cope. This not only dispenses with the usual hinge joint and snap lock, but also makes a more substantial construction that increases the efficiency and life of the flask.

Originally, only very small work was attempted in snap molds. Later, shields or jackets were used to support the molds, but being rigid did not fit perfectly, and consequently did not always give the molds the proper support to carry more than medium weight castings. In larger work, runouts were liable to occur, or "swells" to develop.

This was the condition that Mr. Wood found to exist in his foundry, and desiring to make heavier castings by the use of snap flasks, as well as to mold heavier and larger work in certain size flasks than had been found feasible, he designed a model jacket which would give the desired results, and then proceeded to work out the detailed points of its construction for practical use.

The model jacket consisted of two pairs of small boards, arranged to form a rectangle and joined together at the corners by flexible means. This allowed each side a certain flexibility about its own longitudinal axis, which gave it a chance to move in and out, back and forth and up and down to a certain extent, thus permitting the

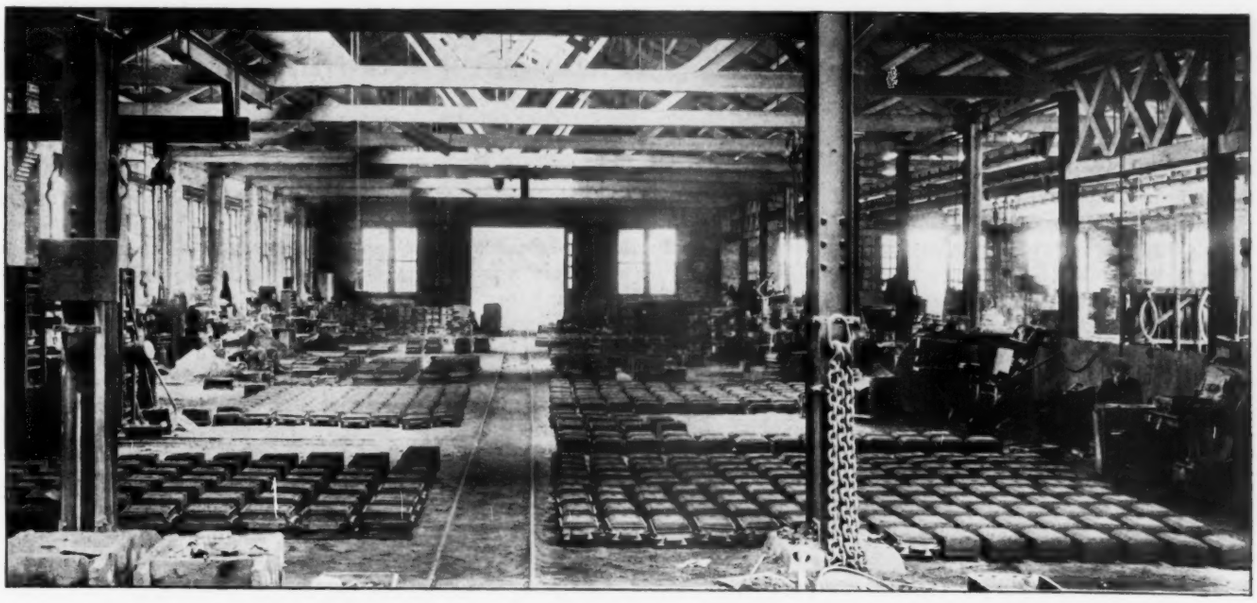


FIG. 1—ON THIS FLOOR OVER 1,000 CASTINGS ARE MADE DAILY USING 100 JACKETS

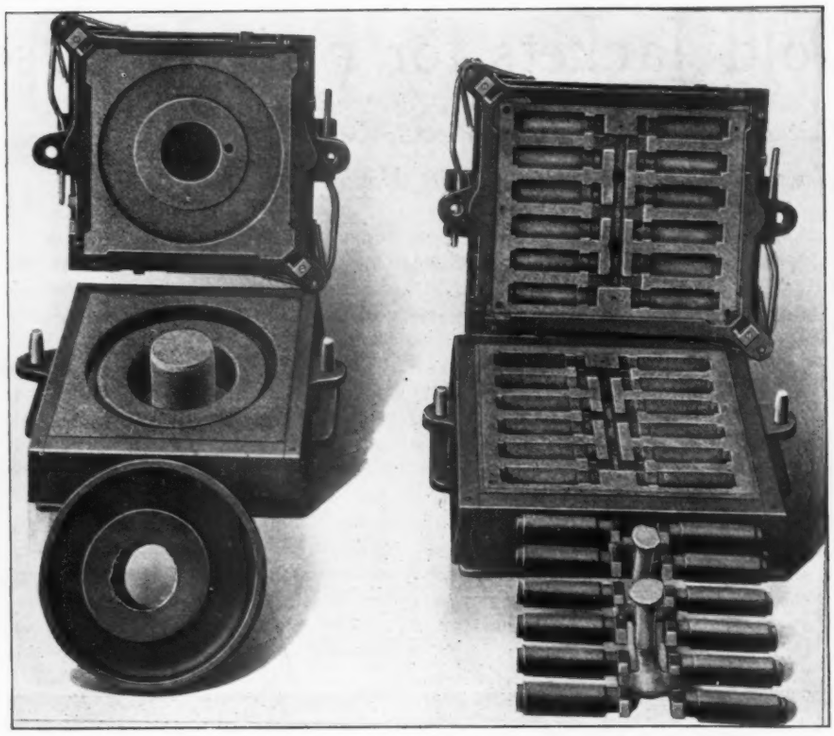


FIG. 2—HEAVY CASTINGS POURED IN ADJUSTABLE JACKETS

jacket to fit perfectly and with equal pressure at all points, about any rectangular block, however distorted, whose original measurements on the sides and ends were the same as the inside measurements of the jacket. Where the block is tapered on its sides, the jacket, when placed about it and pushed down, will tighten and adjust itself automatically and attain a close fit. Where the sides of the block are straight, perpendicular to the plane of the base, the jacket is placed in position and then one end or one side is raised while the opposite end or side is lowered, to tighten and exert a pressure on all sides.

Construction of the Jacket

The patented jacket in its present form is made of cast iron sides with a bolt and spring connection at each of the four corners, as shown in Fig. 3. This connection does not give the full degree of flexibility as the model jacket just described, but provides easily the largest amount that would ever be required for the jacket to fit snugly about a mold made in any flask in condition for use. In short, the joints are capable of universal action to any degree which might be necessary in the operation for which the jacket is designed. The sides of the jacket are slightly tapered, for use with tapered flasks, as these have been found more satisfactory than the snap flask with straight sides.

Being made of cast iron, the sides of the jacket will not burn, spring or dent, while the flexible construction minimizes the danger of breakage and permits the use of light sections, thus keeping down the weight. For jackets of larger sizes than are now being built, Mr. Wood plans to use steel in order to secure a satisfactory plane surface for the sides, angled or ribbed to prevent springing.

The accompanying illustrations will serve to convey a more complete understanding of the usefulness of this jacket. The mold shown in Fig. 3 purposely was made of very irregular shape. The corners were not right angles and the ends and sides were inclined at different angles, showing to what extent the jacket will adjust itself to fit the mold. The cope and drag are supported with equal pressure and the parting is sealed by the jacket, practically eliminating the possibility of a run-out.

Such complete support of the sides of the mold makes it possible to cast satisfactorily heavier work in snap molds, and also permits the use of patterns of larger area. There needs be only a sufficient amount of sand bearing at the parting to carry the weight of the cope. At the right in Fig. 2 is shown a mold, supported by the flask, in which were cast 12 heavy bushings, while encased in a Wood's jacket. At the left in Fig. 2 is shown a plate coupling, 19¼ inches in diameter, molded in a flask 21 inches square, with 5/16-inch sand strips, thus allowing a sand bearing of slightly over ½ inch. This mold also was poured while encased in a Wood's adjustable jacket, and shows the large area of mold which can be used.

Cost of Equipment

The cost of equipment for this class of work is materially reduced by the use of these jackets, as seven to ten jackets used in connection with one snap or taper flask will take the place of 50 to 75 solid flasks, at less than one-fifth the cost and at the same time show an equal, if not greater, output of good castings. After pouring, the jacket is removed and transferred to another mold, and there need be no question about which flask was used for any one mold, as long as the dimensions are the same, on account of the flexibility of the jacket. As the jacket has already been removed for further use, the mold is shaken out by simply turning over the bottom board, the same as with a snap mold where no jacket had been used.

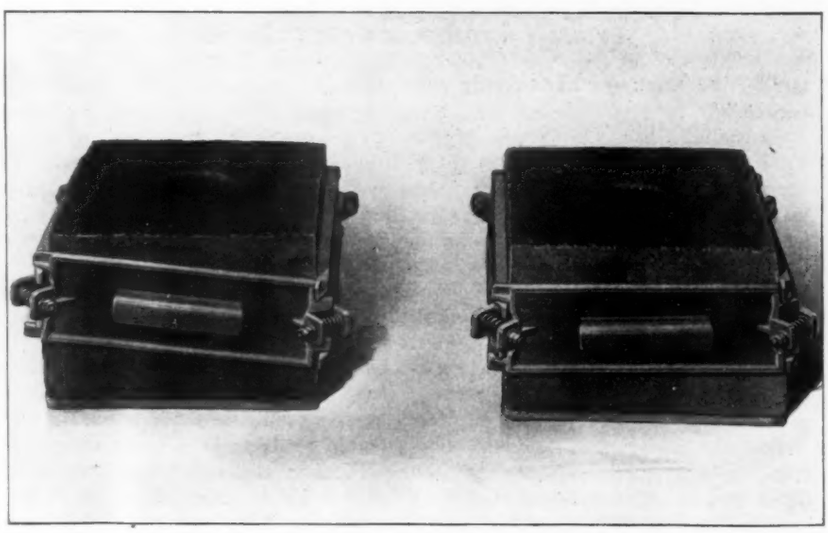


FIG. 3—JACKETS FITTED TO IRREGULAR MOLDS

International Combination Molding Machine

An interesting combination molding machine with several new features will be exhibited at the foundry convention in Chicago by the International Molding Machine Co., Chicago. The machine is built in two styles, one being designed simply for turning over the mold and drawing the pattern and the other for performing jar ramming, turn-over and pattern drawing operations. The first or simpler form is shown in Fig. 1 and the combination jar-ramming, turn-over type in Figs. 2 and 3. A separate cylinder is provided for performing each operation which, it is claimed, insures a minimum consumption of air.

In the combination machine, the ramming section consists of a complete jarring machine built on a heavy one-piece base which extends the entire length of the machine The movement of the jarring piston is actuated by a gate valve located in the pipe line leading from the main air supply. The pressure can be regulated according to the length of stroke required for the weight of the mold. When the flask is being rammed, it is said that only the jarring section is subjected to vibration, as the jarring plate to which the pattern plate is fastened is entirely disconnected from other portions of the machine while it rests on the piston table. When the turn-over frame is lifted up to turn the mold over onto the receiving brackets, the jarring plate is automatically locked to the turn-over frame by means of studs connected to sliding levers.

To turn the mold over, the valve leading to the center cylinder is opened. This forces the piston down, bringing with it the heavy piston rod that passes up through the cylinder cover and connects with a shaft which passes through the arms of the turn-over frame. The downward action of the piston rod causes the frame to raise, and when it has passed just beyond the perpendicular, the air is exhausted and the mold is lowered to a horizontal position. Air is then admitted to the drawing cylinder in order to raise the receiving bed up to the mold. The clamps then are

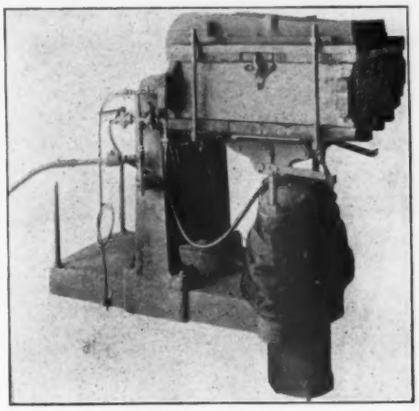


FIG. 1 — TURN-OVER MACHINE WITH FLASK RESTING ON RECEIVING BRACKETS

removed and the air in the drawing cylinder is exhausted, lowering the mold away from the pattern. The height of the receiving brackets may be adjusted according to the depth of the flask. The draw of the machine is limited only by the movement of the drawing piston.

The stops which limit the movement of the turn-over frame when the mold is lowered preliminary to drawing are adjustable so that the proper angle can always be maintained between the plane of the frame and the drawing piston. These machines are built in several sizes and for very large work are provided with two or more turn-over cylinders. An automatic oiling system keeps all working parts properly lubricated. The machines are designed particularly for use in automobile shops and other foundries handling large quantities of duplicate work,, such as cylinders, crank cases, pistons, gear housings, water fittings, heavy engine parts, boiler doors, etc.

One of these machines was recently installed in a heating apparatus foundry, where it is used for molding 38-inch round sections. The output is said to be 35 flasks in four hours, using three men. When the same pattern is molded on the floor, it is said that three molders turned out 24 flasks in a similar time.

The Wilson Foundry & Machine Co., recently incorporated at Pontiac, Mich., for $400,000, has rehabilitated the old foundry of the Flanders Mfg. Co., and will do a general gray iron casting business, specializing in automobile cylinders. Charles B. Wilson, formerly general manager of the Ferro Machine & Foundry Co., Cleveland, is president and general manager of the new company; D. R. Wilson, formerly with the Ferro Machine company, vice president and sales manager; C. E. Killinger, secretary and treasurer; A. Weber, foundry superintendent; William Short, chemist, and C. Fleming, master mechanic. The plant contains a floor area of 75,000 square feet and has a capacity of 40 to 50 tons daily.

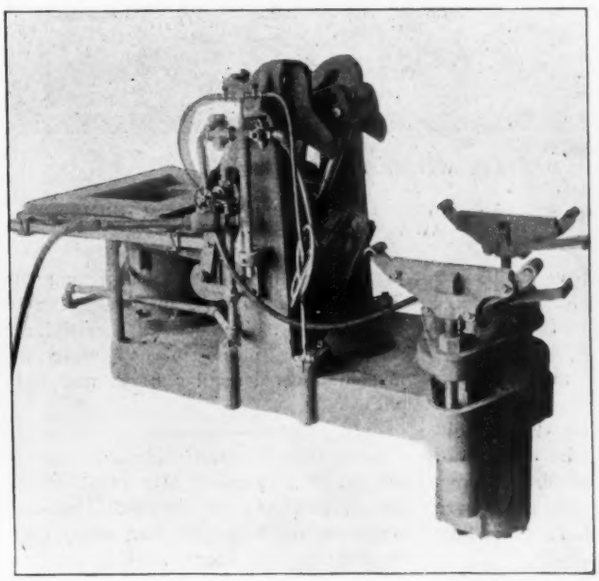


FIG. 2—COMBINATION MACHINE IN RAMMING POSITION

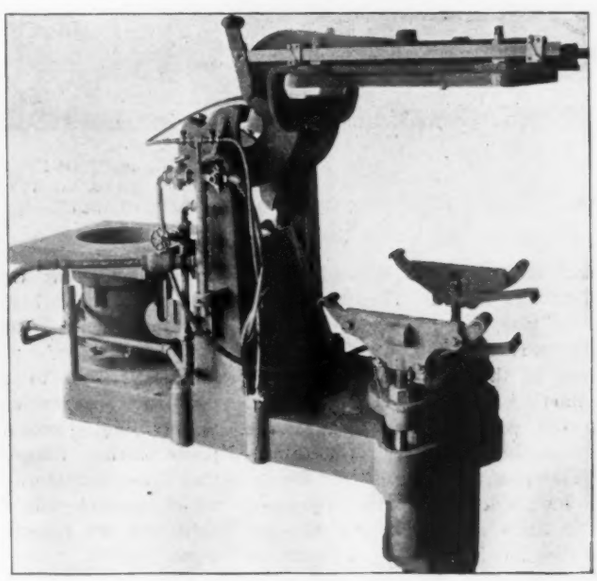


FIG. 3—COMBINATION JAR-RAMMING, TURN-OVER MACHINE IN PATTERN DRAWING POSITION

Pridmore Combination, Jar-Ramming, Rock-Over Machine

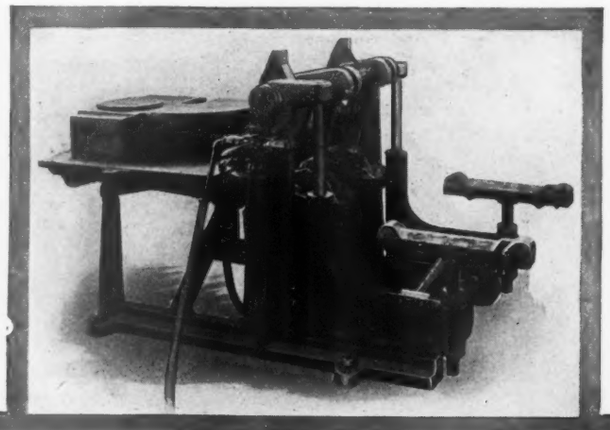
One of the principal features of the Henry E. Pridmore exhibit at the International Amphitheatre, Chicago, Sept. 5 to 11, will be the new combination electric driven jar-ramming and power, rock-over drop molding machine shown in the accompanying illustrations. An effort has been made in designing this machine to combine simplicity with efficiency in operation. The machine consists of only three elements, a standard Pridmore electric jarring machine, a simple rock-over frame, and three air cylinders. Two of the cylinders are utilized to roll over the flask, and the third controls the draw mechanism. By a special arrangement of of valves, only one lever is employed to control the roll-over drop and return. When the flask has been placed on the table of the jarring machine and filled with sand, the operator pulls the clutch lever at the back of the machine and gives the mold the required number of jolts. Then the bottom board is clamped in place, and the operator pushes the control lever on the side of the machine to the left, thus starting the roll-over operation. When the pattern board leaves the jarring machine table, it is automatically clamped to the roll-over frame. With his free hand the operator turns a little stop-cock and the vibrator begins its work. A push of the main control lever to the right brings the flask rest up to the proper position to receive the flask. The clamps are then removed and the controlling lever is moved slightly toward its neutral position. This exhausts the air from the draw cylinder and the mold is dropped away from the pattern. Again the control lever is pushed to the left and the pattern is rolled back onto the jarring machine table, where it is automatically released from the roll-over frame.

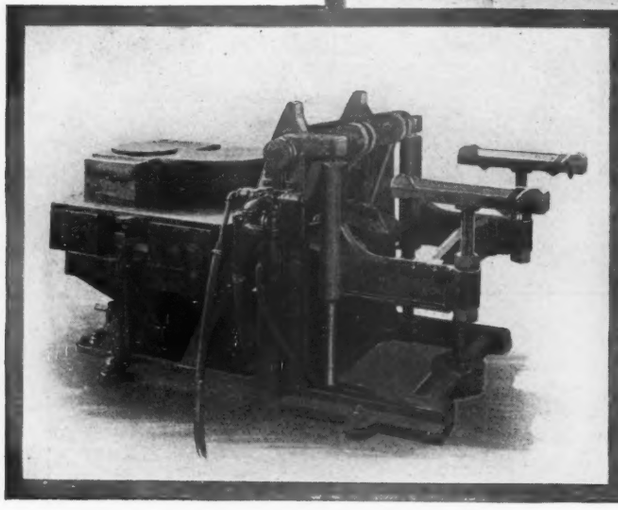
Special precautions have been taken to insure the maintenance of the correct alignment of the draw mechanism. The flask rests are fastened to a cross beam which supports the draw arms that travel vertically on two steel uprights which are fixed to the main frame of the machine.

This is said to give an unyielding construction, placing the burden of maintaining alignment on the upright posts, rather than on the piston of the draw cylinder. The draw arms, which encircle the upright posts, are split and fitted with rollers to reduce wear.

The flask rests automatically adjust themselves to crooked or uneven bottom boards. The rests also can be spread 9 inches to accommodate longer flasks. This is provided for by four holes in the cross beam.

The production on this machine is based, it is said, almost entirely on how fast the sand can be put into the flasks. Two laborers are necessary, one to operate the control lever and both to shovel sand. In some instances, it is more advisable to have three men in order to shovel the sand more rapidly. Where large quantities of duplicate castings are produced, it will pay to feed the sand to the flask through a gravity chute.





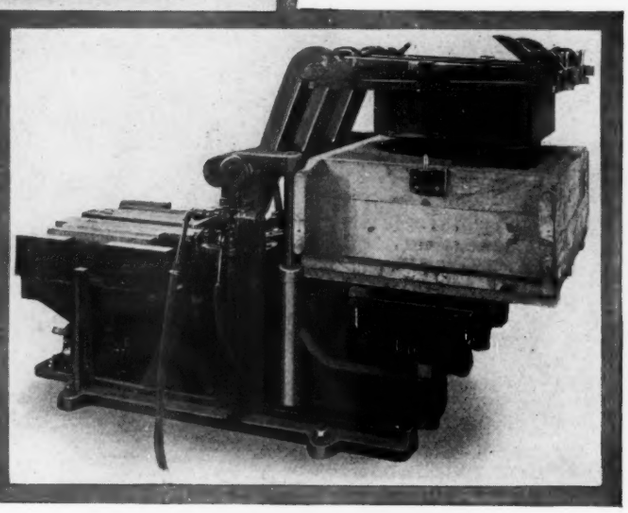


FIG. 1—POWER ROCK-OVER DROP MACHINE WITHOUT JARRING ATTACHMENT

FIG. 2—PATTERN IN POSITION ON JARRING TABLE READY TO RECEIVE FLASK

FIG. 3—FLASK RAMMED, ROCKED OVER AND DROPPED AWAY FROM PATTERN

Sulky Sand Riddler

The J. S. McCormick Co., Pittsburgh, now is offering to the foundry trade a sulky sand riddler adapted to riddling all kinds of sand used in foundry operations. Being mounted on wheels, this device can be moved to any portion of the foundry floor and it can be utilized to prepare the heaps for the various foundry floors. The machine is operated by a motor, either direct or alternating current. The device is well balanced and can be moved easily. The wheels are of large size, making it possible to move the machine over irregular floors and sand piles.

Alexander Watson Cadman, head of the A. W. Cadman Mfg. Co., Pittsburgh, and one of the oldest manufacturers of brass in that city, died recently at his home in Edgwood, a suburb of Pittsburgh. He was born in Allegheny 67 years ago and succeeded his father in business.

FIG. 1—HOPPER AND FLUSHING RIM CASTINGS

FIG. 2 — SPECIAL THREE PART IRON FLASK FOR HOPPER

FIG. 3—PATTERN STAND WITH HOPPER PATTERN AND DRAG IN POSITION

Rig for Molding Sanitary Ware

E. B. Andes & Co., Lancaster, Pa., recently have designed a special equipment for molding cast iron hoppers for a manufacturer of sanitary ware. The castings consist of the hopper bowl and the flushing rim. A specially designed three-part iron flask, Fig. 2, is used for each mold. The parts of the flask are interchangeable.

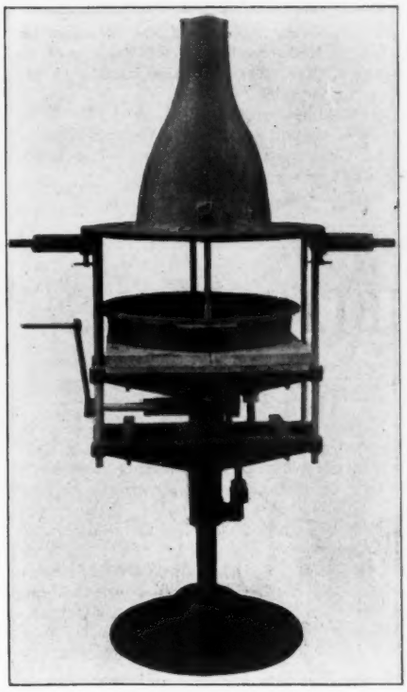


FIG. 4 — PATTERN LIFTING MACHINE SHOWING PATTERN LIFTED FROM DRAG

In making the molds, a pattern stand, supporting the match plate pattern and drag, is placed on a jolt machine and rammed in the usual manner. When the drag is finished, a bottom board is attached and the mold is rolled over and placed on a special pattern lifting machine. This device raises the pattern sufficiently clear of the sand to permit of its being safely lifted the rest of the distance by hand.

The cheeks also are molded on a jolt machine, a hoist being used to lift the finished cheek off the pattern. The copes are made in a special pattern drawing machine and are rammed by hand. The flushing rims are made with a match plate pattern and the concave walls are cored with a green sand core packed on an arbor. It is claimed that by the aid of this outfit, the production has been increased more than eight fold, compared with hand molding. The saving in weight secured by patterns of lighter section, and more accurate molding are also considerable factors in the reduction of the cost.

Personals

S. Proctor Brady has been elected president of the recently reorganized Poole Engineering & Machine Co., Baltimore.

Dwight O. Barrett has been made superintendent of the Charles City Engine Co., Charles City, Ia. He was formerly connected with the Heer Engine Co., Portsmouth, Ia.

Ralph W. Deacon, formerly metallurgical superintendent of the British American Nickel Corporation, Ltd., Nickelton, Can., has been made superintendent of the U. S. Metals Refining Co., Chrome, N. J.

Henry A. Carpenter, of the General Fire Extinguisher Co., Providence, R. I., was chairman of the committee on arrangements of the Providence foundrymen who entertained the members of the New England Foundrymen's Association at a clam bake on Aug. 12.

Thomas H. Mirkil Jr. has accepted the position of resident manager of the Treadwell Engineering Co., Easton, Pa., with office at 1011 Chestnut street, Philadelphia. He recently resigned as vice president and general manager of the Poole Engineering & Machine Co., Baltimore.

Orton Lee Prime has resigned as president and general manager of the Prime Steel Co., manufacturer of open-hearth and crucible steel castings, Milwaukee, Wis., and will devote his entire attention to the Prime Mfg. Co., Railway Exchange building, Milwaukee, Wis., railway supplies. Charles E. Nelson, well known steel casting expert of Waukesha, Wis., has succeeded Mr. Prime. The Prime Mfg. Co. will not engage in actual manufacture at present.

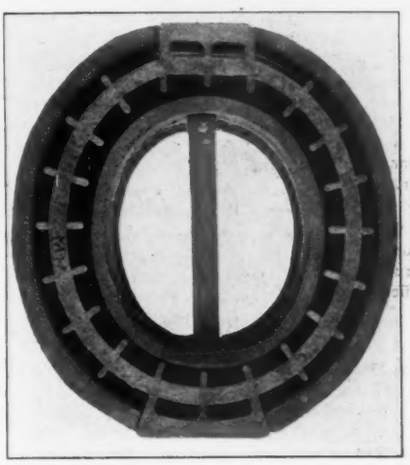


FIG. 5—IRON CORE BOX FOR FLUSHING RIM

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The new foundry of the Deere Harvester Co., Moline, Ill., is nearing completion.

An addition, 50 x 80 feet, is being built to the casting shop of P. F. Mork, Beloit, Wis.

The Meadville Malleable Iron Co., Meadville, Pa., is building an addition to its annealing department.

The Wichita Foundry Co., Wichita, Kans., is erecting a 40 x 42-foot building and plans to make other additions at an early date.

The Allentown Rolling Mills Co., Allentown, Pa., is building an addition to its Liberty street foundry.

An addition 45 x 90 feet will be erected to the forge shop of the Johnston-Jennings Co., Cleveland.

Improvements are being made to the Reynolds-Chalou foundry, Second street, Troy, N. Y., of which James Hislop is owner.

The Amarillo Foundry, Amarillo, Tex., is erecting an addition on Polk street, to care for an increase in business.

The Buffalo Forge Co., Broadway and Mortimer streets, Buffalo, is planning to erect an extensive addition to its foundry.

Knowlton Bros., Camden, Me., machinists and founders, are erecting a building on Mechanic street to replace one burned last winter.

The North Star Iron Works, Southport, Ore., is planning the erection of a foundry and has secured a site.

An additional building is being erected at the plant of the American Sawmill Machinery Co., Hackettstown, N. J., to house the sand cleaning department.

George H. Folger & Son, Grand Rapids, Mich., machinists and patternmakers, have purchased a factory, and will erect a two-story addition, 33 x 55 feet.

A. H. Smith, Salem, Mass., is erecting a plant in that city to replace one recently destroyed by fire. A traveling crane and other foundry equipment will be purchased.

Work will be startely shortly on the erection of a gray iron foundry by the Swedish Crucible Steel Co., Windsor, Ont. The main office of the company is at Detroit.

The Metropolitan Iron Foundry, Metropolitan avenue, Brooklyn, N. Y., will erect a one and two-story brick foundry, 50 x 200 feet, at a cost of about $25,000.

The Springfield Foundry Co., Springfield, Mass., is erecting an addition to its Indian Orchard, Mass., plant which will be used as a core room and an extension of the shipping department.

The foundry of the Singer Mfg. Co., Elizabeth, N. J., will be raised from one story to three stories. The company also will erect a 27 x 30-foot sub-power station for its rolling mill.

The Richardson & Boynton Co., Dover, N. J., whose plant was recently destroyed by fire, has placed a contract with the Lackawanna Steel Co., Buffalo, for the erecting of a foundry, 140 x 448 feet; a cleaning and pattern shop, 60 x 300 feet; machine, testing and mounting shop, 100 x 300 feet. During construction of these buildings the company will fill orders from the small foundry which remained after the fire. A great deal of special machinery for use in assembling all kinds of stoves, boilers and ranges was destroyed and will have to be replaced.

The Kyle Mfg. Co., Lancaster, O., manufacturer of black and galvanized iron specialties, stoves, etc., has commenced the erection of a stove foundry. The building will be a one-story brick structure, 100 x 400 feet. The company was recently incorporated for $85,000 by Frank W. Raitze, William D. Bauman, R. C. Kyle, George W. Moss and C. M. Rowles.

The Pittsburgh Foundry & Machine Co., Liberty street, Pittsburgh, manufacturer of gray iron castings, has purchased a half-acre site at Thirty-sixth street and the Baltimore & Ohio railroad on which it will erect a foundry. The building will be of steel, 50 x 160 feet, with a 30-foot leanto running the entire length on each side of the main building. The company also has completed plans for an extension to its plant at Salem, O.

The Cleveland Metal Products Co., Cleveland, which operates a steel stamping and porcelain enameling plant, is building an addition 100 x 266 feet, to be used for the manufacture of aluminum cooking utensils. A casting building, 57 x 83 feet, and a mill, 82 x 100 feet, also will be erected to provide sheets and castings. The company will produce aluminum sheets and castings for the market.

Among the Brass Founders

The Wakefield Brass Co., Vermilion, O., will build a brass foundry.

A plant will be erected at Redcliffe, Alta., Can., by the Imperial Brass Co., Chicago, for the manufacture of hardware specialties, pumps, valves, faucets, etc.

Fire recently damaged the brass foundry of the Hillen Mfg. Co., Louisville, Ky.

The Mueller Brass Works, Sarnia, Ont., plans to erect an iron foundry.

A new shop is being erected by the Marietta Brass, Iron & Foundry Co., Marietta, O. M. W. Keller is superintendent.

The General Aluminum & Brass Mfg. Co., Detroit, has let contracts for constructing a machine shop.

The Titanium Alloy Mfg. Co., Sugar street and Lafayette avenue, Niagara Falls, N. Y., is erecting an addition to its foundry.

The General Bronze Foundry Co., Cleveland, has increased its capital stock from $10,000 to $25,000.

A one-story, 30 x 40-foot brass, aluminum and gray iron foundry will be erected by Daniel I. Brown, at Burlington, N. J.

A machine shop and foundry of brick and steel construction will be erected by the E. R. Caldwell & Sons Brass Co., Syracuse, N. Y., on West Fayette street.

The Columbus Brass Co., Columbus, O., will vacate its plant on Fourth street and occupy only its improved Dublin avenue building.

The aluminum foundry of the Warman & Wolf Co., Madisonville, O., will be moved to Covington, Ky. The company intends to increase the capacity.

The building being erected by J. C. Rath, New Philadelphia, O., aluminum and brass casting manufacturer, is nearly completed. This plant will employ 40 men.

NEW TRADE PUBLICATIONS

AIR COMPRESSOR VALVES.—A 28-page bulletin issued by the Ingersoll-Rand Co., 11 Broadway, New York City, is devoted to the Ingersoll-Rogler valves for air compressing cylinders. This type of valve is illustrated and described in detail and its application to air compressors also is shown.

ELECTRIC HOISTS.—An 8-page bulletin issued by the Pawling & Harnischfeger Co., Milwaukee, entitled "The Application of the Electric Hoist" shows numerous service views of the electric hoist manufactured by this company. These views include the use of this hoist for handling lifting magnets, conveying pipe in pipe foundries, handling plates in steel plants and for service over foundry floors.

SAND-HANDLING MACHINERY. — The Standard Sand & Machine Co., Cleveland, in a 24-page catalog illustrates and describes its extensive line of sand mixing and tempering machines, sand screens, pulverizers, dryers, elevators, sand and mold conveyors, and rolling and bonding machines. An installation at the plant of the Ford Motor Car Co., Detroit, which serves a large number of squeezers, is particularly novel and effective. A drag conveyor at the plant of the Buckeye Steel Casting Co., Columbus, also is shown, as well as an installation of a sand mixer of large capacity in the plant of the Nordberg Mfg. Co., Milwaukee.

PORTABLE FLOOR CRANE AND HOIST.—A 32-page booklet issued by the Canton Foundry & Machine Co., Canton, O., is devoted to this company's portable floor crane and hoist. This device is adapted to wide application in industrial plants generally, and particularly where heavy material must be handled. In addition this hoist serves as an auxiliary to overhead cranes, relieving them of the work of handling the lighter loads and as the hoist is portable, the work can be carried to parts of the shop not commanded by large hoisting equipment. The catalog is well illustrated and shows various applications of this device in numerous different types of industrial establishments. The hoist is described in detail and a price list also is included.